REPORT

Morning Commuter Traffic Crossing American Legion Bridge

Prepared For:

Virginia Department of Transportation

Prepared By:

Vanasse Hangen Brustlin, Inc.

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Crossing American Legion Bridge

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VDOT AmLegionBridge

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Executive Summary

Purpose of the Study

This study was conducted to identify and quantify current morning commuting patterns of Virginia and Maryland residents crossing the Potomac River via the American Legion Bridge. The purpose of this effort was to better understand overall origin and general destination patterns, as well as gain some insight on commuter destinations along employment corridors. This study was designed to collect a limited amount of data and to present findings of the data collection effort. It is hoped that data and findings will be useful in traffic management decisions and ongoing and future studies.

Study Assumptions

- Commuting between 6:00 AM and 9:00 AM is representative of normal patterns.
- The location of the American Legion Bridge provides a unique situation where Virginia vehicles observed just north of the bridge and Maryland vehicles observed just south of the bridge during the morning commuting hours would most likely have crossed the bridge.
- Due to the time of day of the observations, the most likely origin of vehicle trips will be from the home.
- Summer vacation variances in commuting patterns will not be a significant factor in data collected in October/November.
- By carefully selecting data collection sites, reasonable conclusions can be drawn regarding general trip origins and destinations.
- The number of through-vehicles and out-of-state registered vehicles captured was not large enough to affect findings.

Methodology

- Fifteen sites were selected, five (5) in Maryland and ten (10) in Virginia, for data collection using infra-red video cameras between the hours of 6:00 AM and 9:00 AM.
- Sites selected were chosen to obtain a representative sample of commuters between the two states who are using the American Legion Bridge and to gather data to indicate trip origins and general destination patterns.
- Efforts were made to avoid distracting commuters during the field data collection, and to limit the cost of the large data collection effort, without calling attention during the data collection, and to minimize the cost of data collection.
- Data collection of license plate images was conducted during a Tuesday through Thursday schedule for the period starting October 22, 2003 through November 20, 2003.
- Once the data was collected, it was submitted to the respective Departments of Motor Vehicles (Virginia or Maryland) for matching the license tag numbers to zip codes. The information provided by the Departments of Motor Vehicles did not include the names of registered owners.
- The next step was to plot zip code locations of the vehicles passing through each site (Maryland origin zip codes for Virginia observation sites, Virginia codes for Maryland sites).

Analysis

- The combined total traffic volume at the Maryland sites indicates that 23,563 vehicles came through the five sites with 12, 796 of that total being Virginia registered vehicles (54%). (see Table 3-1)
- If Site 4, which is not contiguous to I-495, is removed from the totals, Virginia license plates constitute 63% of all vehicles observed. (see Table 3-1)
- Process of matching license plates observed to origin zip codes had a very high success rate: 92% and 95% for Virginia and Maryland license plates, respectively. (see Table 3-2 & Table 3-5)
- Analysis indicated that, based on VDOT historical traffic data, a very large sample size was obtained.
- The very high percentages noted above indicate the reliability of the data collected.
- The combined total traffic volume at the Virginia sites indicates that 35,553 vehicles came through the ten sites with 13,632 of that total being Maryland registered vehicles (38%)(not all Maryland to Virginia commuters were captured in this study since, due to cost considerations, not all ramps were sampled and no sites were selected south of the I-495/I-66 interchange). (see Table 3-4)
- For the sites contiguous with I-495 (omitting Sites 12, 13, 14, 15), the ratio of registered Maryland vehicles to the total observed is 63%. (see Table 3-4)
- Observations on the Dulles Access Road and the Dulles Toll Road show that 30% of the vehicles observed originated in Maryland. (see Table 3-6)

Findings

All numbers are referenced to the observed and matched observations collected by this study. Estimates of actual commuter volumes should take into account the sample size and the match rate.

Use of infra-red cameras (1 per lane) captured over 59,000 vehicles, when compared to other data collection techniques, represents a very large sample of vehicles observed at data collection points.

Virginia Commuters

- **Figure 3-1** through **Figure 3-3** show various composite views of the home zip codes of Virginia vehicles observed in Maryland.
- Of the 12,796 registered Virginia vehicles observed at Maryland sites, 11,783 license plates were matched by DMV.
- Of the 11,783 Virginia vehicles matched, 549 vehicles were counted at both Site 1 and Site 4. Eliminating duplicated counting resulted in 11,234 Virginia vehicles analyzed.
- Of the 11,234 Virginia commuters observed crossing the American Legion Bridge, 63% (7,130) have destinations toward the east in Maryland while 37% (4,104) head west or northwest of the Beltway.
- Virginia zip codes west of the Beltway and north of I-66 have the highest concentration of commuters to Maryland (see Figure 3-3)
- Of the 6,775 Virginia vehicles originating in the sector west of I-495/I-95, 68% (4,596) head toward the east in Maryland, while 32% (2,179) travel west and northwest of the Beltway.
- Of the 4,459 Virginia commuters residing inside the Beltway and east of I-95, 57% (2,534) have destinations toward the east in Maryland, with 43% (1,925) heading west and northwest.
- The highest single match from Virginia to Maryland was between Virginia zip code 22003 (Annandale) and Maryland Site # 5 (Bethesda).

Maryland Commuters

- **Figures 3-5** through **3-7** show various composite views of the home zip code locations of Maryland vehicles observed in Virginia.
- Of the 13,632 registered Maryland vehicles observed at Virginia sites, 12,896 license plates were matched by DMV.
- Of the 12,896 Maryland vehicles matched, 676 vehicles were counted at both Site 11 and Site 15. Eliminating duplicated counting resulted in 12,229 Maryland vehicles analyzed.
- Of the 12,229 Maryland commuters observed crossing the American Legion Bridge, 35% (4,300) have destinations east of the Beltway in Virginia while 65% (7,929) head west (see Table 3-6).

- A comparison of **Figure 3-5** to **Figure 3-6** reveals that travel originates from similar Maryland zip codes no matter whether the vehicles go east or west of Beltway, however, travel to the west is higher.
- Of the 5,641 Maryland vehicles originating in the sector west of the Beltway and Georgia Avenue, 52% (2,954) head toward points west of the Beltway in Virginia, while 48% (2,687) travel toward the east.
- Of the 6,588 Maryland vehicles originating in the sector east of the Beltway and Georgia Avenue, 24% (1,613) travel east of the Beltway in Virginia, while 76% (4,975) travel toward the west.
- The highest single match from Maryland to Virginia was between Maryland zip code 20854 (Potomac) and Virginia Site # 6 (George Washington Parkway)

Overall

- **Figure 3-8** which is a plot of all matched traffic in Maryland and Virginia, visually illustrates that there is a concentration of commuters around I-495 and along the western radial routes (I-270 in Maryland and Route 7, the Dulles Toll Road, Route 50 and I-66 in Virginia) that utilize the American Legion Bridge between Maryland and Virginia during the morning commuting period of 6:00 AM to 9:00 AM.
- In view of the large sample size and matching rate, data from this study may be useful in other on-going or future studies examining commuter patterns.

1 Introduction

Virginia and Maryland Transportation officials have been questioned by members of the Joint Legislative Committee for Interstate Transportation about commuting patterns of Virginia and Maryland residents crossing the Potomac River over the American Legion Bridge. Transportation officials of the Virginia and Maryland Departments of Transportation know that there is daily commuting between the two states, but limited factual data exists.

The Virginia Department of Transportation (VDOT), in cooperation with the Maryland Department of Transportation, using a VDOT On-Call Transportation consulting contract, commissioned Vanasse Hangen Brustlin, Inc. to identify commuting patterns across the American Legion Bridge.

Purpose of Study

This study was conducted to identify and quantify current morning commuting patterns of Virginia and Maryland residents crossing the Potomac River via the American Legion Bridge. The purpose of this study effort was to better understand overall origin and general destination patterns, as well as gain insight on commuter destinations along employment corridors. This study was designed to collect a limited amount of data and to present findings of the data collection effort. It is hoped that data and findings will be useful in traffic management decisions and ongoing and future studies.

Assumptions

- Commuting between 6:00 AM and 9:00 AM is representative of normal patterns.
- The location of the American Legion Bridge provides a unique situation where Virginia vehicles observed just north of the bridge and Maryland vehicles observed just south of the bridge during the morning commuting hours would most likely have crossed the bridge.
- Due to the time of day of the observations, the most likely origin of vehicle trips will be from the home.
- Summer vacation variances in commuting patterns will not be a significant factor in data collected in October/November.
- By carefully selecting data collection sites, reasonable conclusions can be drawn regarding general trip destinations.
- The number of through-vehicles and out-of-state registered vehicles captured was not large enough to affect findings.

2
Methodology

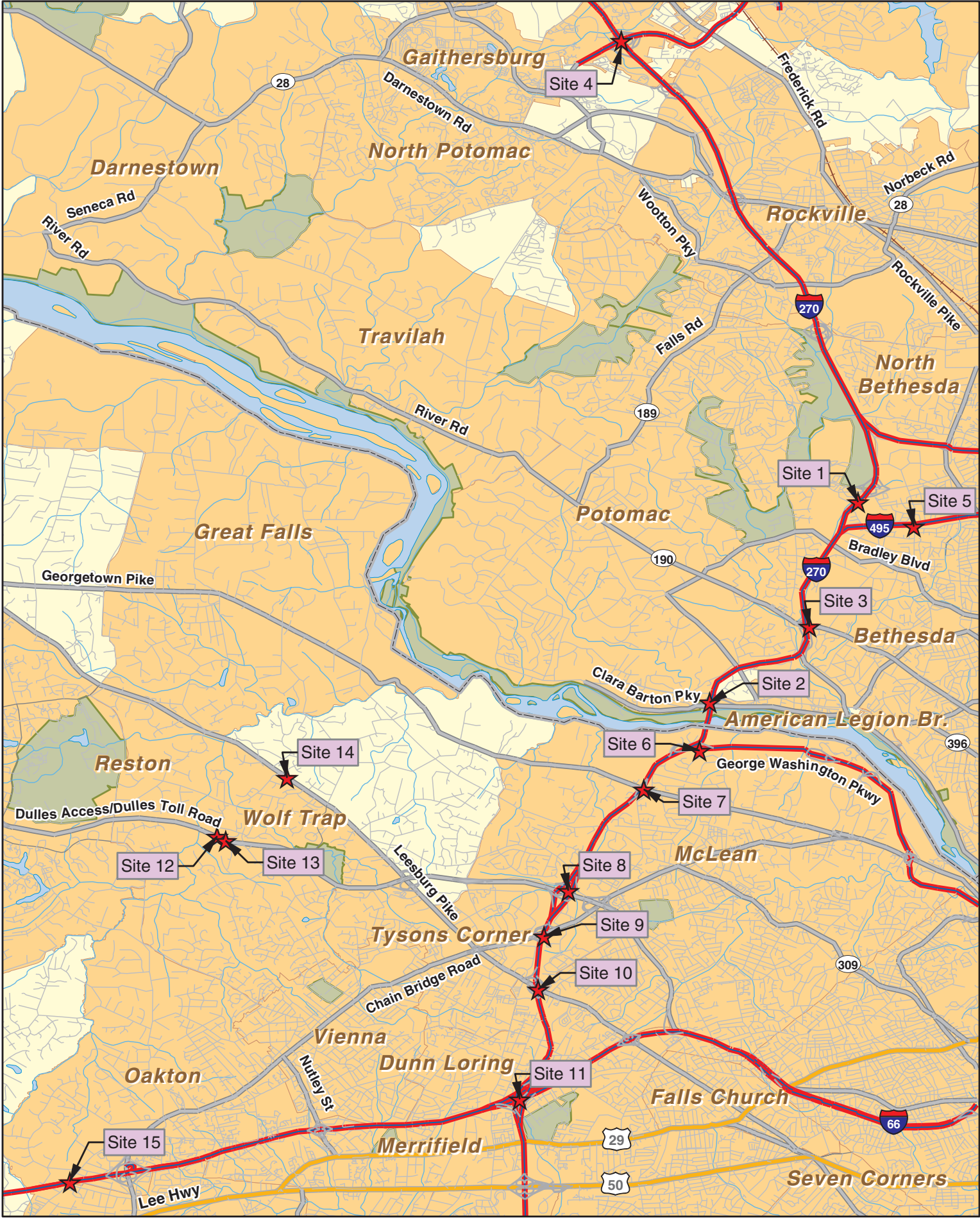
Fifteen sites were selected, five (5) in Maryland and ten (10) in Virginia for data collection using infra-red video cameras between the hours of 6:00 AM to 9:00 AM (see **Figure 2-1** and Table 2-1 for locations). The fifteen sites selected were chosen in order to observe commuting vehicles most likely crossing the American Legion Bridge while keeping observation sites to a reasonable number. Budget considerations resulted in elimination of several sites, based partially on ability to infer some information by supplementing with data from other VDOT efforts.

License plate images were captured during a Tuesday through Thursday schedule for the period starting October 22, 2003 through November 20, 2003. A review of continuous traffic count data near the American Legion Bridge shows that the weekday counts, Monday through Friday, between 6:00 and 9:00 AM have very small variation during the time of this study's data collection period.

The license plate data was collected at off-ramps, overpasses and bridge location sites for the main vehicle travel routes in the Northern Virginia and Maryland region using infra-red cameras. One camera per lane with a field-of-view of approximately 4.5 feet was used to insure all passenger vehicles were captured and the license plate numbers were automatically recorded to reduce human transfer error. (Other vehicles such as trucks with multiple license plates or vehicles with license plates not readable or license tags not in the 4.5 feet field-of-view were not captured.) This technology allowed the data to be collected quicker and without the use of external lighting thereby reducing impact on traffic. From the recorded license plate numbers, zip codes were obtained from the Virginia and Maryland Departments of Motor Vehicles without any owner names. Only Virginia tags observed at Maryland sites and Maryland tags observed at Virginia sites were matched to addresses, to obtain the desired origin zip code information.

The Maryland sites selected captured traffic going northbound on I-495 from Virginia exiting at Clara Barton Parkway, River Road, I-495 east of I-270 Spur (Green Tree Road Bridge), and the I-270 Spur just north of I-495 (Westlake Terrace Bridge just south of Rockville). These locations capture the Virginia commuters most likely using the American Legion Bridge.

The Virginia sites selected captured traffic traveling southbound on I-495 from Maryland exiting at George Washington Parkway eastbound, Georgetown Pike, Dulles



VHB Vanasse Hangen Brustlin, Inc.

Figure 2-1
Site Location Map

Table 2-1
License Plate Data Collection Sites

MD	Site 1	I-270 Spur NB at Westlake Terrace Bridge	3 Lanes
MD	Site 2E	Clara Barton Parkway Off-Ramp EB at I-495 NB	1 Lane
MD	Site 2W	Clara Barton Parkway Off-Ramp WB at I-495 NB	1 Lane
MD	Site 3E	River Road Off-Ramp EB at I-495 NB	1 Lane
MD	Site 3W	River Road Off-Ramp WB at I-495 NB	1 Lane
MD	Site 4	I-270 Mainline NB at Sam Eig Highway Bridge	4 Lanes
MD	Site 5	I-495 Mainline EB at Green Tree Road Bridge	3 Lanes
VA	Site 6	George Washington Pkwy Off-Ramp EB at I-495 SB	1 Lane
VA	Site 7E	Georgetown Pike Off-Ramp EB at I-495 SB	1 Lane
VA	Site 7W	Georgetown Pike Off-Ramp WB at I-495 SB	1 Lane
VA	Site 8	I-495 SB Off-Ramp to Dulles Connector to I-66 EB	1 Lane
VA	Site 9E	Chain Bridge Road Off-Ramp EB at I-495 SB	1 Lane
VA	Site 9W	Chain Bridge Road Off-Ramp WB at I-495 SB	1 Lane
VA	Site 10	Leesburg Pike Off-Ramp EB at I-495 SB	1 Lane
VA	Site 11	I-495 Mainline Off-Ramp SB to I-66 Mainline WB	2 Lanes
VA	Site 12	Dulles Toll Road WB at Trap Road Bridge	4 Lanes
VA	Site 13	Dulles Access Road WB at Trap Road Bridge	2 Lanes
VA	Site 14	Leesburg Pike West of Dulles Toll Road WB	2 Lanes
VA	Site 15	I-66 Mainline WB at Jermantown Road Bridge	3 Lanes

Toll Road Extension eastbound towards I-66, Chain Bridge Road, Leesburg Pike eastbound, and I-66 westbound. Traffic exiting I-495 to access the Dulles Toll Road and the Dulles Access Road in the westbound direction was captured at Trap Road Bridge. Sites over 5 miles west of the Beltway (along VA 267, I-66 and Route 7 in Virginia) were selected to provide data on Maryland commuters along these long employment corridors. Due to cost considerations, not all ramps were sampled and no sites were selected south of the I-495/I-66 interchange.

Tysons area Beltway exits included all off-ramps headed eastbound at Dulles Connector, Routes 123 and 7, as well as Route 123 exit headed westbound. No mainline southbound Beltway sites were included and all traffic proceeding south of I-66 exits was not captured. Budget considerations caused exclusion of several desirable data collection sites; decisions were guided by focus of analysis on likely destinations beyond the Beltway, and by the perceived ability to complement the data gathered with information in previous studies and efforts.

The next step of the process was to plot zip code origins of the vehicles passing through each site (see Appendix B). The site locations allowed the study team to know the general direction of the vehicles passing through the site. The results of that process are illustrated in Section 3 – Analysis.

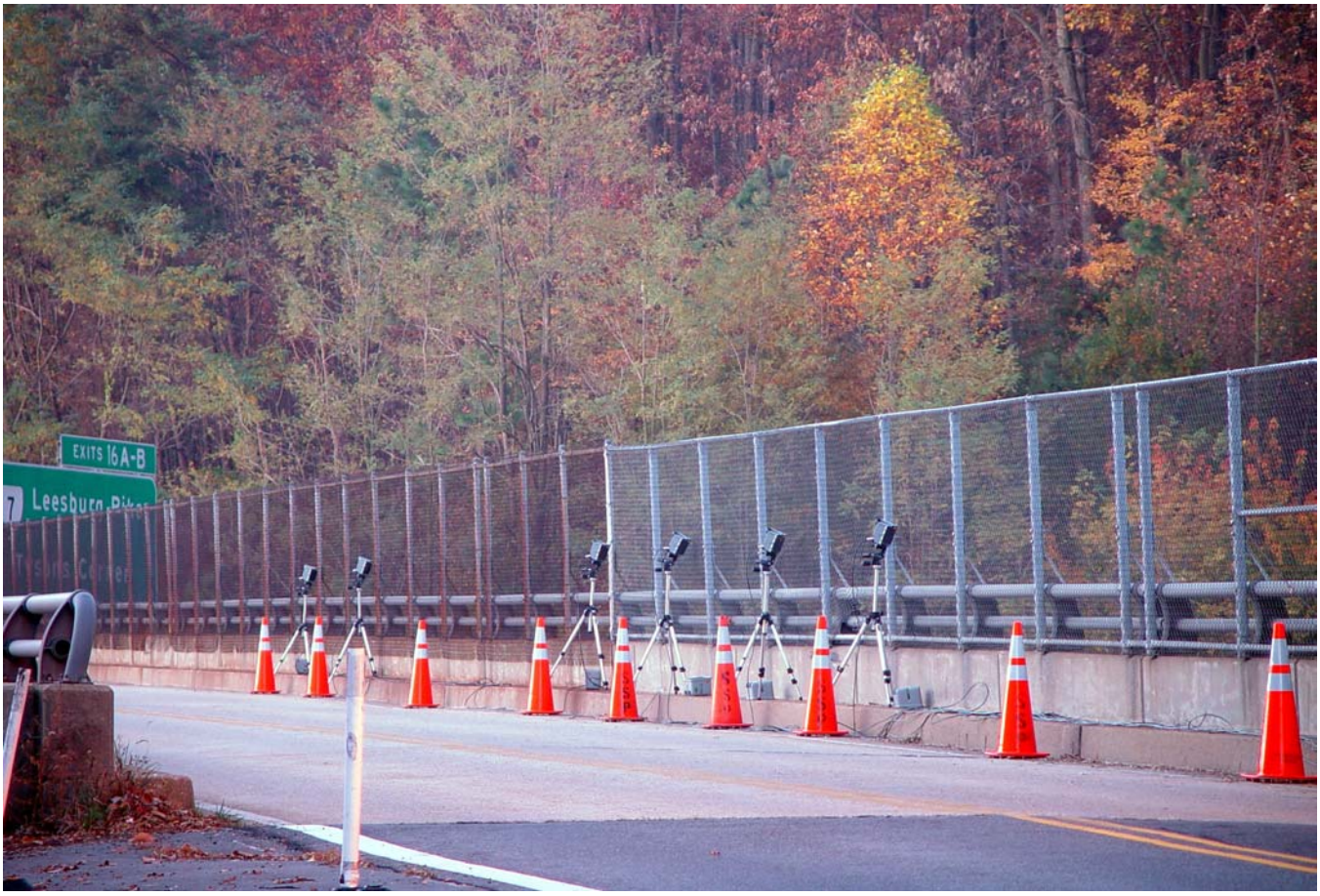


Figure 2-2

Image taken at 7:40 AM EST on Tuesday November 4, 2003 at Trap Road Bridge monitoring six lanes of commuter vehicle traffic traveling west on the Dulles Toll Road (Site 12) & the Dulles Access Road (Site 13).

3 Analysis

The analysis section of this report consists of a summary of license plates collected in each state and a more detailed presentation of Virginia vehicles in Maryland and Maryland vehicles in Virginia with the use of zip code data provided by the Virginia and Maryland Departments of Motor Vehicles. Greater detail is shown in Appendix A – Data Collection by Site by Lane that provides, in table and chart form, the number of observations by site by lane in half hour increments from 6:00 AM to 9:00 AM.

Maryland Sites

The combined total traffic volume at Maryland data collection Sites 1-5 was 23,563 vehicles on 14-lanes of interstate mainlines and ramps on I-495 and I-270 (see Table 3-1). Virginia license plates captured at Maryland sites totaled 12,796 vehicles, or 54% of all vehicles monitored between 6:00 AM and 9:00 AM. If Site 4, which is not contiguous to I-495, is removed from the totals, Virginia license plates constitute 63% of all vehicles observed.

Table 3-1
Summary of Maryland Site Data

	6:00 – 9:00 AM		
Maryland Site #	Total Vehicles Observed	VA Vehicles Observed	% VA Observed
Site 1	6,499	3,260	50%
Site 2E	2,346	1,774	76%
Site 2W	606	414	68%
Site 3E	1,649	1,203	73%
Site 3W	636	382	60%
Site 4	4,672	918	20%
Site 5	7,155	4,845	68%
Totals	23,563	12,796	54%
Totals (w/o 4)	18,891	11,878	63%

Of the 12,796 Virginia vehicles observed at the Maryland sites, the Department of Motor Vehicles was able to match 11,783 vehicle license plates to registration zip codes for a match

ratio of 92% (see Table 3-2). The matching was very high but not 100% because some zip codes were not provided and some of the tags while identifiable as Virginia tags, were not legible.

Table 3-2
Summary of Virginia Vehicles Observed vs Matched at Maryland Sites

	6:00 – 9:00 AM		
Maryland Site #	VA Vehicles Observed	VA Vehicles Matched	VA % Matched
Site 1	3,260	3,060	94%
Site 2E	1,774	1,632	92%
Site 2W	414	390	94%
Site 3E	1,203	1,108	92%
Site 3W	382	351	92%
Site 4	918	852	93%
Site 5	4,845	4,390	91%
Totals	12,796	11,783	92%
Totals (w/o 4)	11,878	10,931	92%

Figure 3-1 shows the home zip code location of Virginia vehicles observed in Maryland traveling in a westerly direction from I-495 and **Figure 3-2** shows the home zip code location of Virginia vehicles observed in Maryland traveling in an easterly direction from I-495.

Maryland Site 4 located at I-270 North at Sam Eig Highway was included to determine the number of Virginia vehicles traveling approximately 8 miles north of Site 1 (Westlake Terrace Bridge) in the I-270 corridor. In addition, Site 4 tells how many Virginia vehicles go past Sam Eig Highway heading north towards Gaithersburg. Of the 918 Virginia vehicles observed at Site 4, approximately 64% (583) were also observed at Site 1. When the number of Virginia vehicles observed at Site 4 is subtracted from the Site 1 total (3,260-583), it indicates that at least 2,677 Virginia vehicles exited I-270 between Site 1 and Site 4. Appendix B shows zip code plots of all vehicles observed at Site 1 and at Site 4. Also, a zip code plot was made of those vehicles observed at both Site 1 and Site 4, which provides a truer picture of the origins at Site 4 that most likely crossed the American Legion Bridge.

Figure 3-3 is a composite of the Virginia zip code origins for all Virginia vehicles observed at Maryland sites.

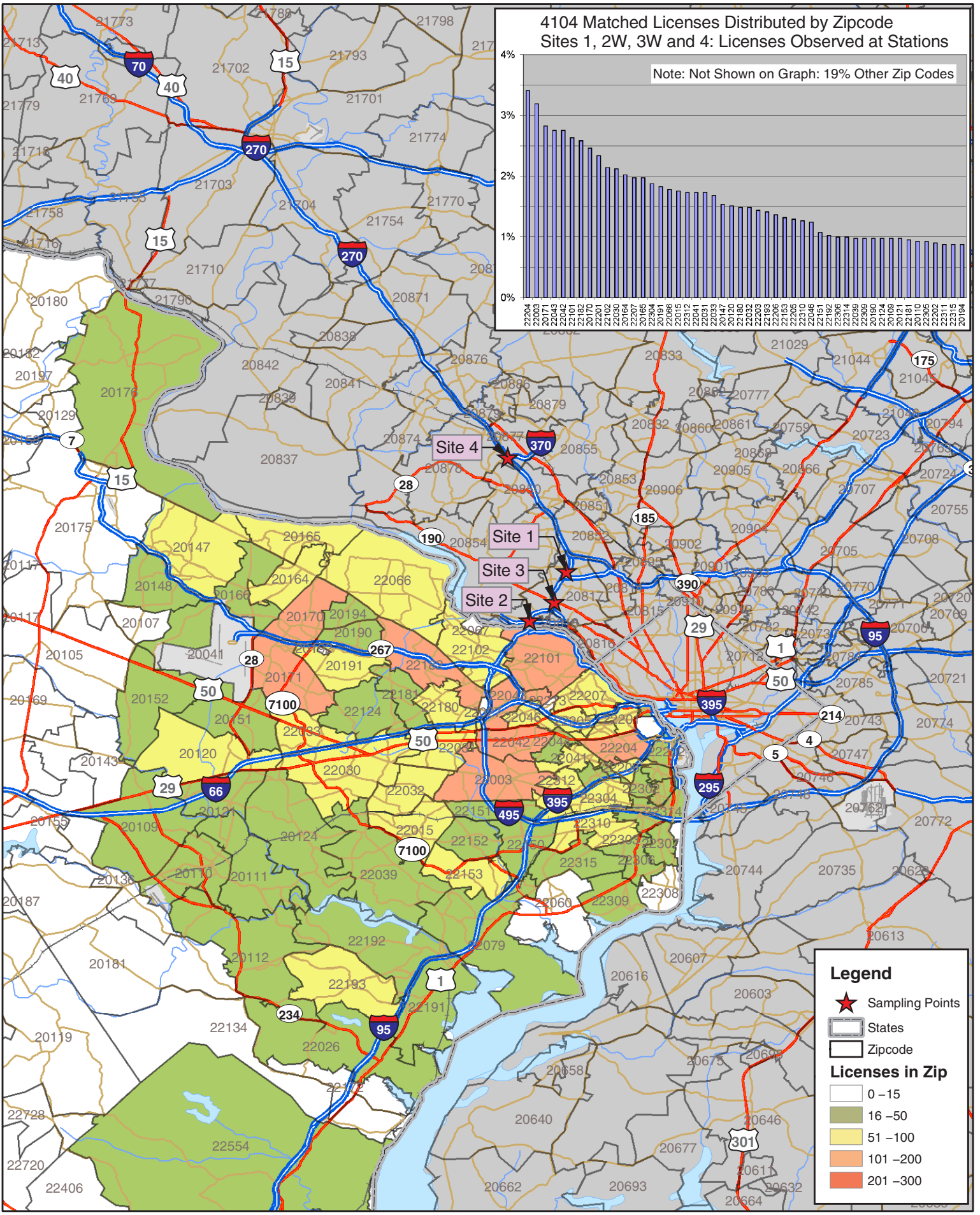


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Figure 3-1
VA Traffic Oriented West of I-495
Matched to Zip Codes (Sites 1,2W,3W,4)

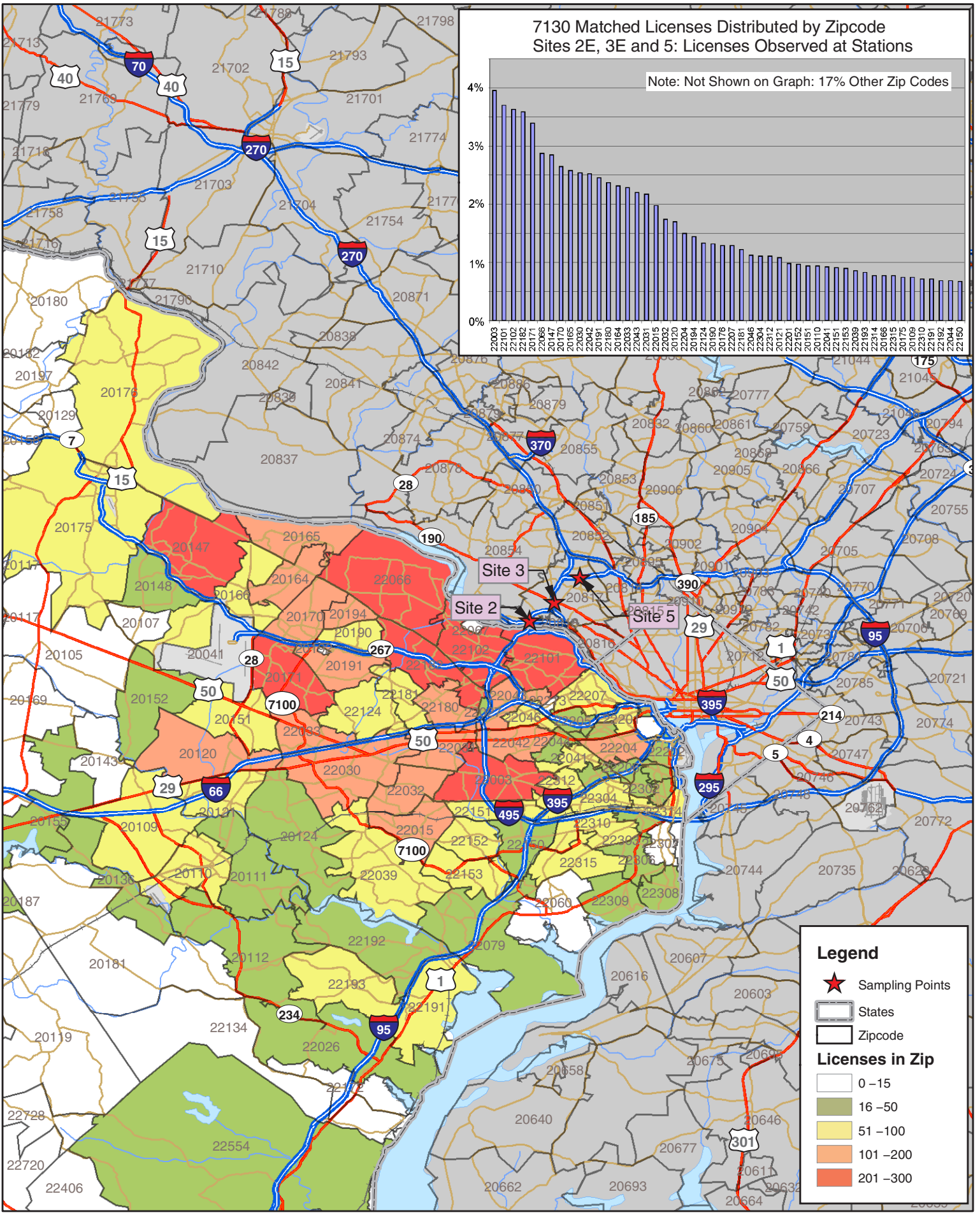

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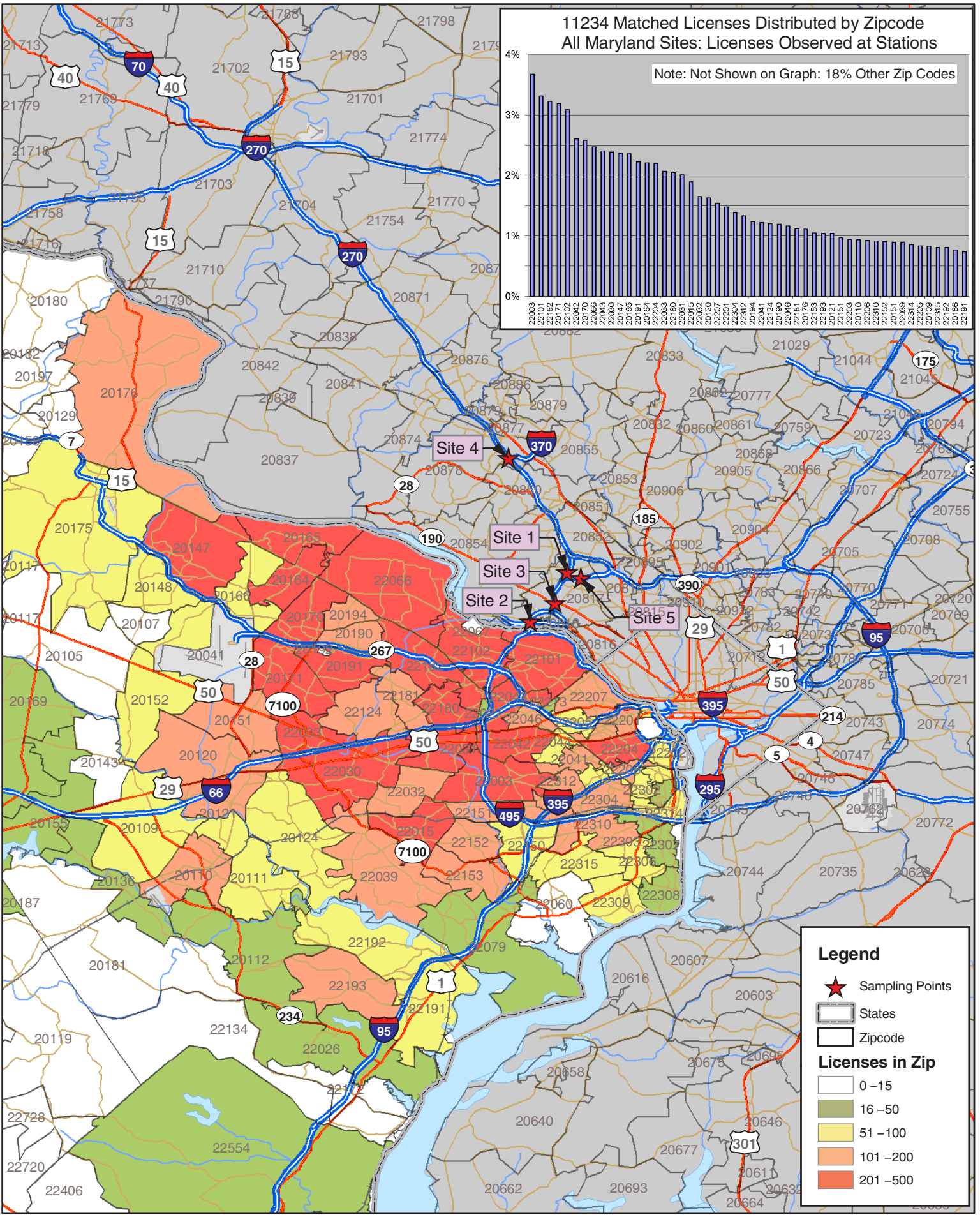
Figure 3-2
VA Traffic Oriented East of I-495
Matched to Zip Codes (Sites 2E,3E,5)



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N

0 2.5 5 10 Miles

Figure 3–3
All Maryland Sites
VA Traffic Matched to Zip Codes
(Sites 1–5)

To gain further insight of the data collected, the zip code origins of the Virginia vehicles matched at Maryland sites were grouped into the following likely origin corridors: Dulles Corridor, I-66 Corridor, Route 15 Corridor, Route 28/7100 Corridor, I-95/I-395 Corridors. (Each corridor consists of nearby zip codes whose residents are likely to use the named Route; some zip codes naturally overlap more than one corridor.) These Virginia corridors were correlated with Maryland observation sites.

Table 3-3 Where Virginia Residents Head (6-9 AM commuter travel)

FROM: Area/ Corridor of residency	# Tags[a]	TO: Beltway WB off-ramps [2W, 3W]	TO: I-270 Corridor [1]	TO: Gaithersburg Area		TO: E.B. Beltway (mainline & off-ramps) [2E, 3E, 5]
				Site 4 thru Site 1 [a]	Site 4 NOT thru Site 1 [b]	
All VA codes	11,234	7% (741)	27% (3,060)	5% (549)	3% (303)	63% (7,130)
Dulles Corridor	2,622	5% (126)	23% (605)	4% (100)	2% (44)	70% (1,847)
I-66 Corridor	2,290	6% (148)	24% (543)	4% (92)	2% (49)	68% (1,550)
Route 15 Corridor	674	5% (35)	20% (136)	2% (16)	1% (5)	74% (498)
Route 28/7100 Corridors	3,690	6% (204)	24% (884)	4% (134)	2% (73)	69% (2,529)
I-95/495 Corridor	3,860	7% (280)	28% (1,088)	6% (214)	3% (119)	62% (2,373)

[a] Tags captured at Site 4that also passed through Site 1 are not included in totals (to avoid double counting)
[b] Likely did not cross American Legion Bridge
[ ] denotes sites included

Table 3-3 shows 63% of all Virginia commuters have destinations east of I-495 while 27% of Virginia residents crossing the American Legion Bridge travel to the I-270 corridor. 70% of the Virginia residents from the Dulles Corridor travel to the east in Maryland while 23% travel to the I-270 Corridor.

A second analysis approach looked at grouping zip codes by sectors: Maryland East and West and Virginia East and West. While the two states are clearly divided by the Potomac River, the east – west divide was subjectively selected as Georgia Avenue/I-495/I-95 (See **Figure 3-4**).

The results of the two approaches are approximately the same with only slight differences due to the different groupings of zip codes.

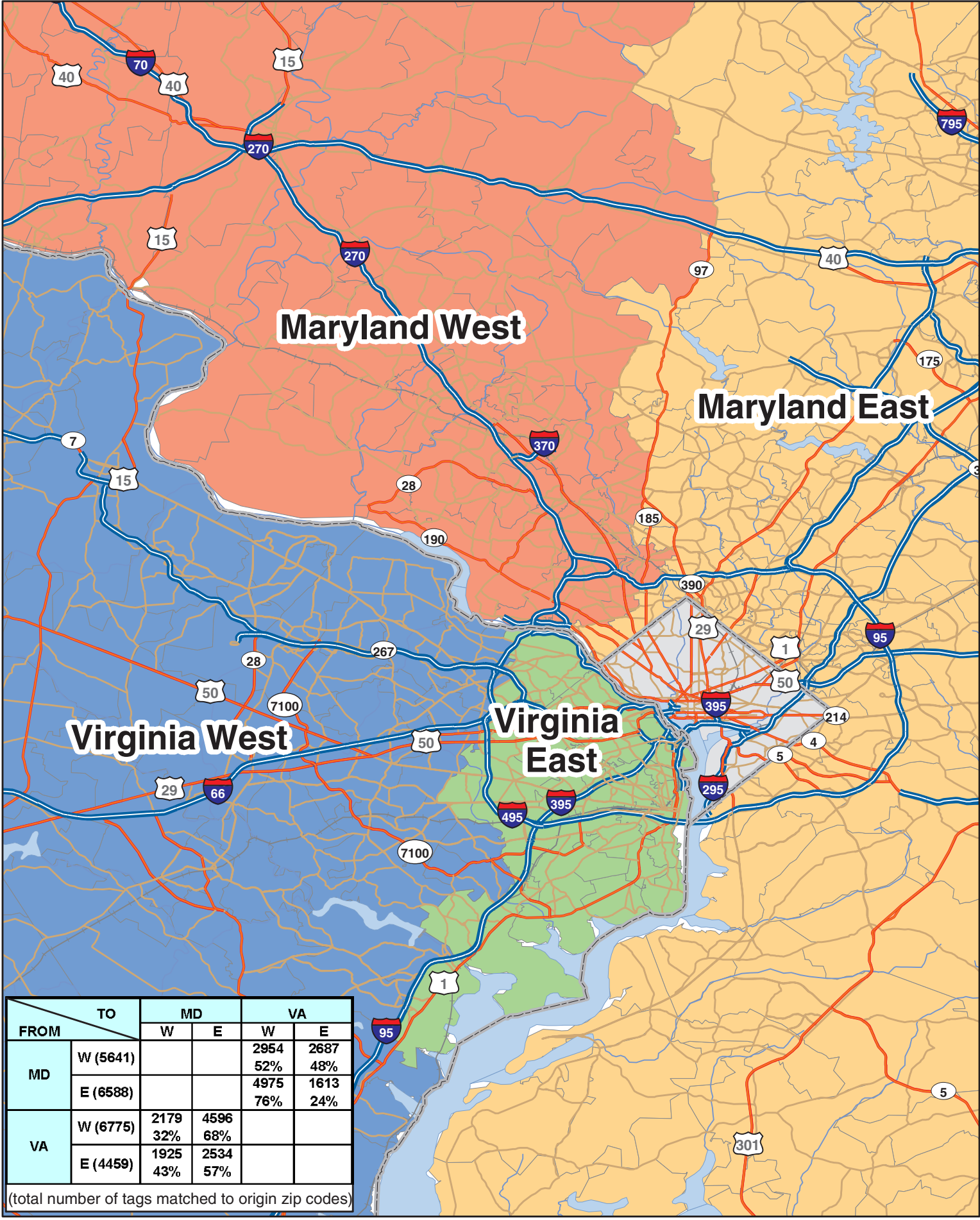
The sector analysis for 11,234 Virginia residents traveling to Maryland shows:

From Virginia West (6,775 vehicles identified)

- To Maryland West: 2,179 (32%)
- To Maryland East: 4,596 (68%)

From Virginia East (4,459 vehicles identified)

- To Maryland West: 1,925 (43%)
- To Maryland East: 2,534 (57%)



FROM \ TO		MD W	MD E	VA W	VA E
MD	W (5641)			2954 52%	2687 48%
	E (6588)			4975 76%	1613 24%
VA	W (6775)	2179 32%	4596 68%		
	E (4459)	1925 43%	2534 57%		

(total number of tags matched to origin zip codes)

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N

0 2.5 5 10 Miles

Figure 3-4
Regional Sector Map

Virginia Sites

The combined total traffic volume at Virginia data collection Sites 6–15 was 35,553 vehicles on 20 lanes of interstate mainline and off-ramps on I-66, I-495, Dulles Toll Road and Dulles Access Road (See Table 3-4). Maryland license plates captured at the Virginia sites total 13,632, or 38% of all vehicles monitored. With the Maryland sites closer to the American Legion Bridge, the higher percentage of Virginia vehicles observed in those closer Maryland sites versus the percentage of Maryland vehicles in the generally more distant Virginia locations seems intuitively reasonable. Looking at the bottom line of Table 3-4, if the four sites (12, 13, 14, 15), not contiguous to I-495 are removed from the totals, the Maryland license plates observed compared to the total vehicles observed becomes 63%, illustrating a very strong commuting pattern.

Table 3- 4
Summary of Virginia Site Data

Virginia Site #	6:00 – 9:00 AM Total Vehicles Observed	6:00 – 9:00 AM MD Vehicles Observed	MD % Observed
Site 6	4,254	2,837	67%
Site 7E	604	449	74%
Site 7W	1,311	876	67%
Site 8	628	412	66%
Site 9E	512	366	71%
Site 9W	2,700	1,761	65%
Site 10	841	431	51%
Site 11	2,726	1,469	54%
Site 12	9,030	2,673	30%
Site 13	1,023	315	31%
Site 14	2,732	379	14%
Site 15	9,192	1,664	18%
Totals	35,553	13,632	38%
Totals (w/o 12,13,14,15)	13,576	8,601	63%

Of the 13,632 Maryland licenses observed at the Virginia sites, the Department of Motor Vehicles was able to match 12,896 for a matching ratio of 95% (Table 3-5). If you remove the data collected at Sites 12, 13, 14, and 15, the matching ratio is still 95%.

Table 3- 5
Summary of Maryland Vehicles Observed vs Matched at Virginia Sites

Virginia Site #	6:00 – 9:00 AM MD Vehicles Observed	6:00 – 9:00 AM MD Vehicles Matched	MD % Matched
Site 6	2,837	2,728	96%
Site 7E	449	418	93%
Site 7W	876	818	93%
Site 8	412	400	97%
Site 9E	366	353	96%
Site 9W	1,761	1,668	95%
Site 10	431	400	93%
Site 11	1,469	1,388	94%
Site 12	2,673	2,499	93%
Site 13	315	299	95%
Site 14	379	359	95%
Site 15	1,664	1,566	94%
Totals	13,632	12,896	95%
Totals (w/o 12,13,14,15)	8,601	8,173	95%

Figure 3–5 shows the home zip codes of Maryland vehicles observed in Virginia traveling in an westerly direction from I-495 and **Figure 3-6** shows the home zip codes of the Maryland vehicles traveling in an easterly direction from I-495 between 6:00 AM and 9:00 AM.

Virginia Site 12 (Dulles Toll Road) had 30% Maryland vehicles and Virginia Site 13 (Dulles Access Road) had 31% Maryland vehicles heading west during the 6:00 AM to 9:00 AM observation period.

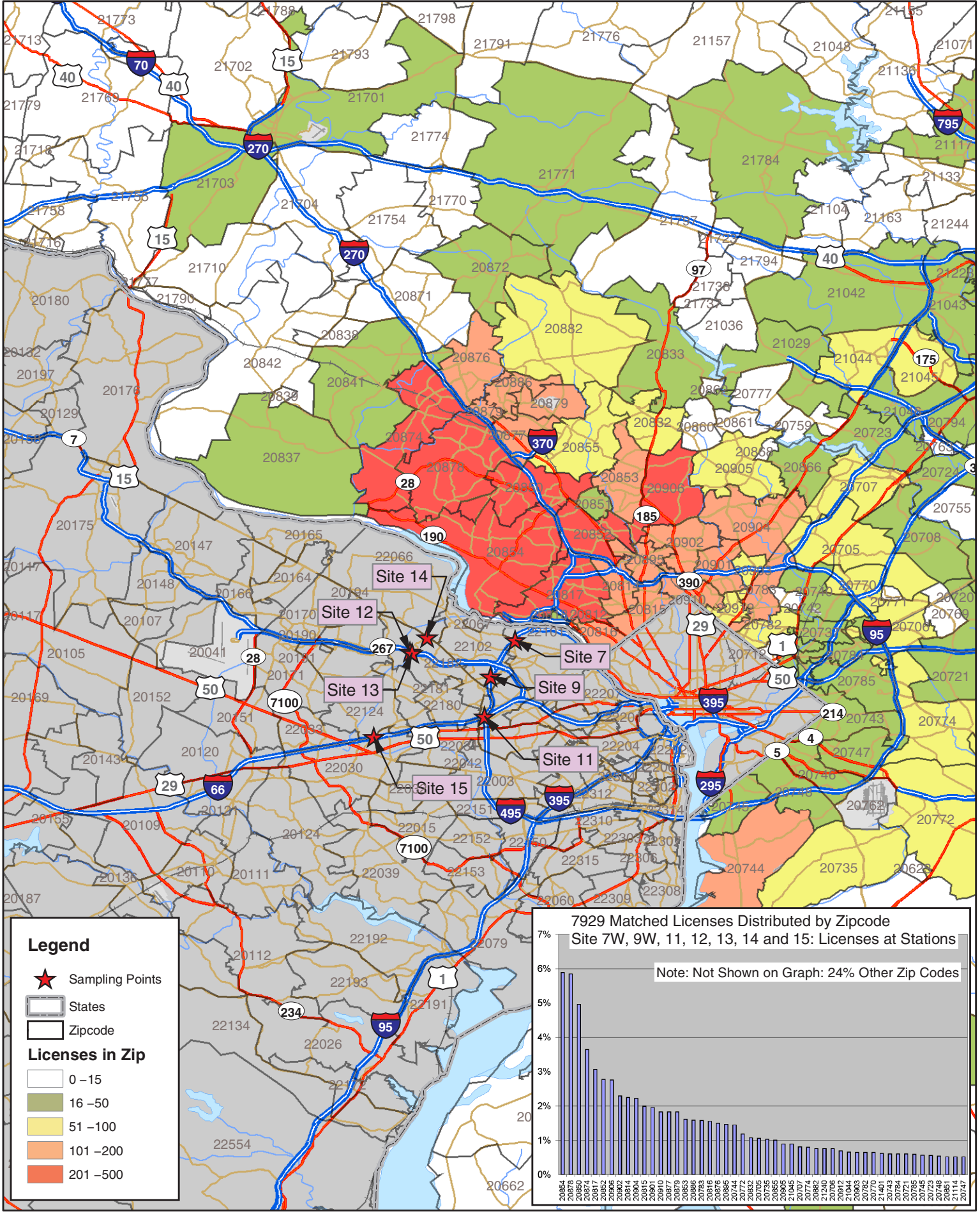

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Figure 3-5
MD Traffic Oriented West of I-495
Matched to Zip Codes
(Sites 7W,9W,11-15)

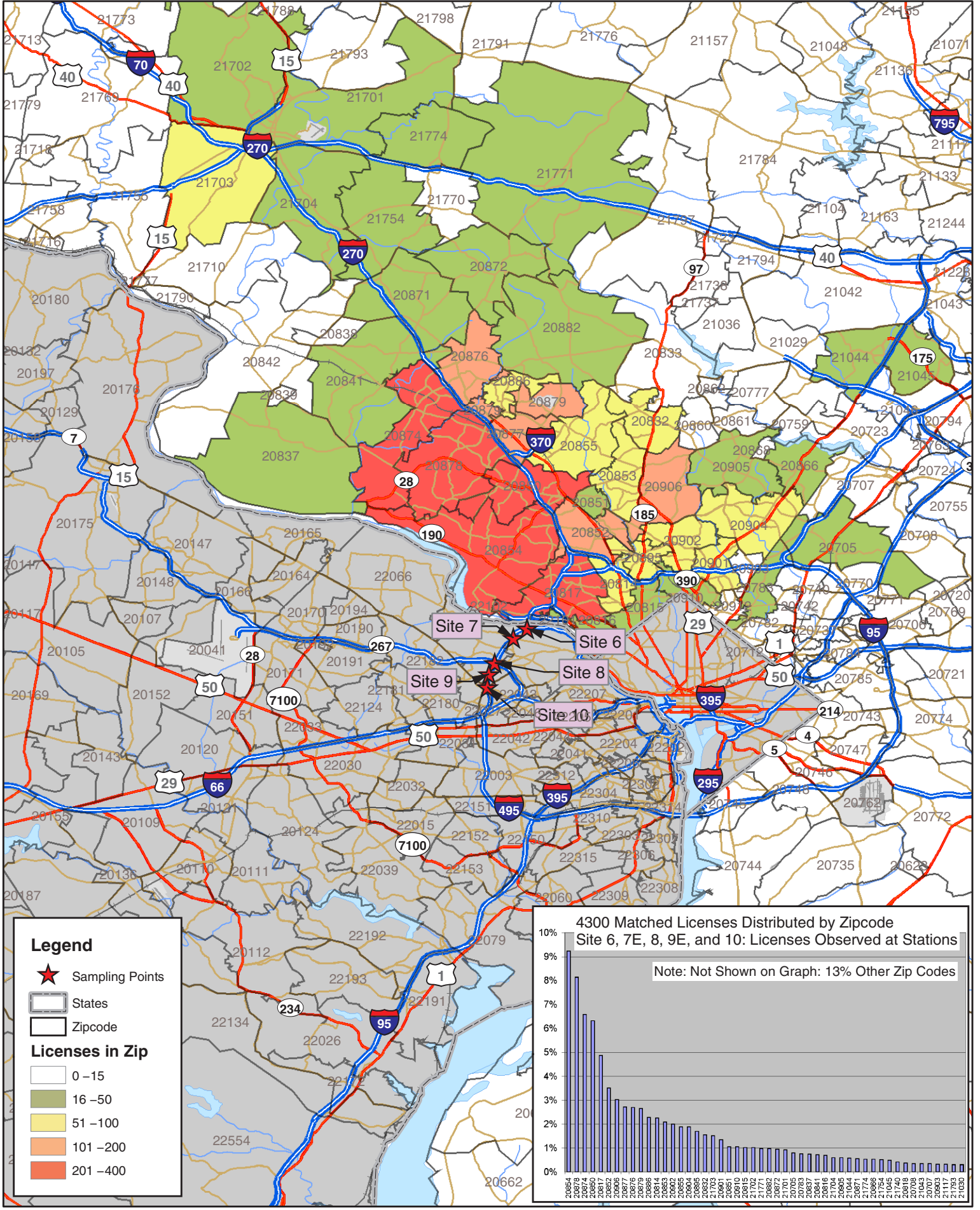

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Figure 3-6
MD Traffic Oriented East of I-495
Matched to Zip Codes
(Sites 6,7E,8,9E,10)

Virginia Site 15, (I-66 West at Jermantown Road Bridge), was included to determine the proportion of Maryland vehicles that continue westward several miles beyond I-495 (Site 11). In addition, Site 15 volumes illustrate how many Maryland vehicles go past Route 123 at the City of Fairfax. Of the 1,566 Maryland vehicles observed at Site 15, 674 were also observed at Site 11. By subtracting the number of Maryland vehicles observed at Site 15 that passed through Site 11 (1,469-674), it indicates that 795 Maryland vehicles exited I-66 between Site 11 and Site 15. Appendix B shows zip code plots of all vehicles observed at Site 11 and at Site 15. Also, a zip code plot was made of those vehicles observed at both Site 11 and Site 15, which provides a truer picture of the origins of vehicles that were observed at Site 15 that most likely crossed the American Legion Bridge.

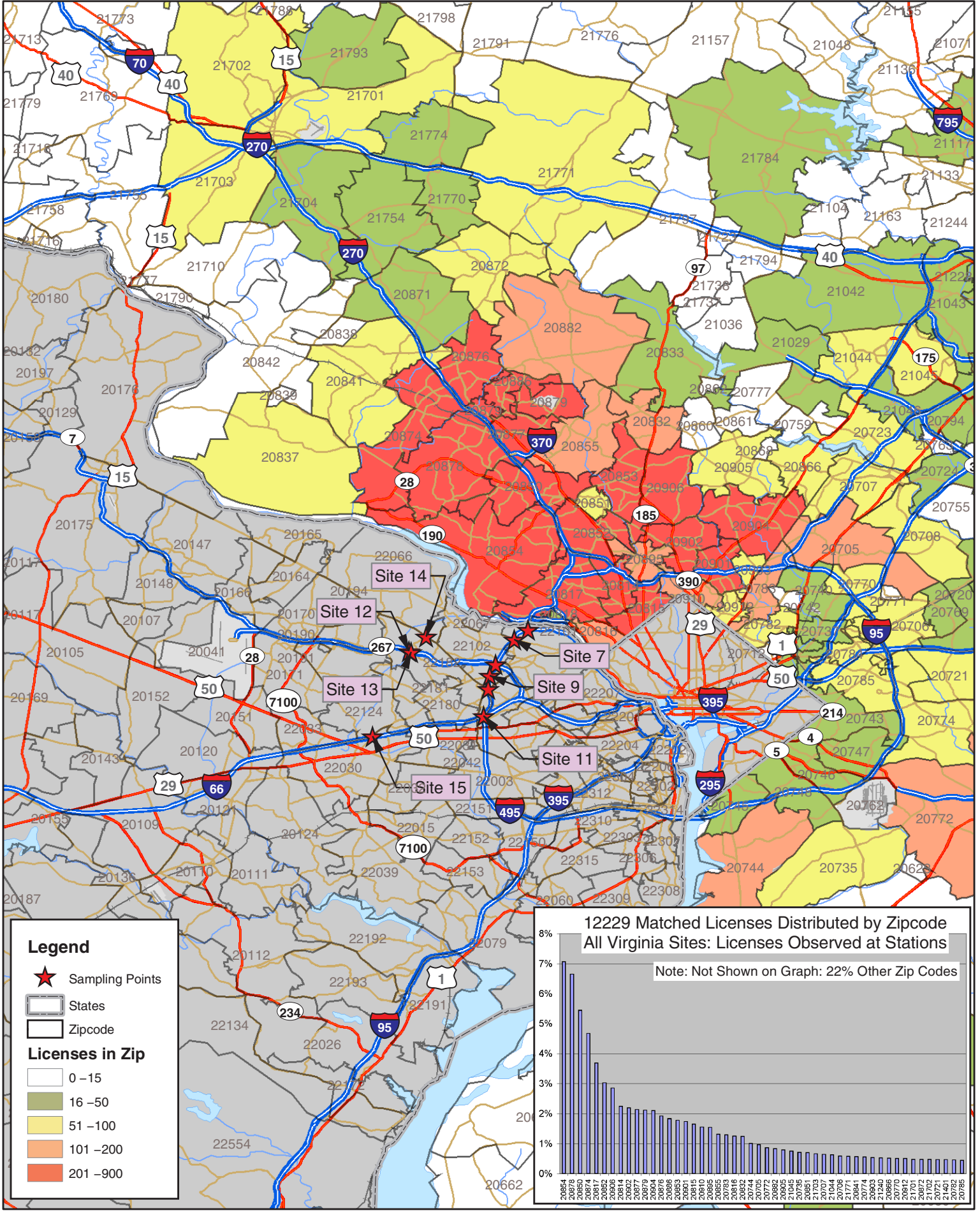
Figure 3-7 is a composite of the Maryland zip code origins for all Maryland vehicles observed at Virginia sites between 6:00 AM and 9:00 AM.

Figure 3-8 is a composite of the matches from all of the Maryland and Virginia sites between 6:00 AM and 9:00 AM.

License plate to zip code match rates were very high for both states (95 and 92% for Maryland and Virginia vehicles respectively). If another observation technique had been used instead of infra-red cameras with automated license plate text conversion, it is doubtful that a data sample would have been as accurate or as large.

Since historical traffic data is not available at any of the site locations for this study, it is not possible to determine a definitive sample size. However, an estimate of sample size can be approximated by comparing VDOT historical traffic data on northbound I-495 (22,926) with the number of Maryland site observations without Site 4 (18,891) which yields an 82% sample. The 22,926 count was developed from an April 2002 48-hour count at the American Legion Bridge, factored to a 6-9 AM weekday count averaged for October 2003. Site 4 is excluded from the sample size calculation because vehicles captured at Sites 1, 2, 3 and 5 should account for all vehicles crossing the American Legion Bridge in the northbound direction. For the southbound direction, a comparison of a VDOT October 2003 average weekday 6-9 AM count (20,619) with the Virginia site observations without Sites 12, 13, 14, and 15 (13,576) reveals a 66% sample. The southbound comparison is not felt to be as reasonable since many exits from I-495 were not included. The technology used to collect the observations used in this study is generally superior to the technology used to collect VDOT historical traffic counts and therefore, citing an exact sample size does not seem appropriate. It is reasonable to say that the overall sample size is at least 66% and is likely closer to 82%.

As mentioned earlier, one infra-red camera per lane was used in the data collection effort. When considering other options, non-infrared cameras would have required external lighting because of the time of day and could have been a distraction to the motorists resulting in safety issues. Collecting the data through human observation would have

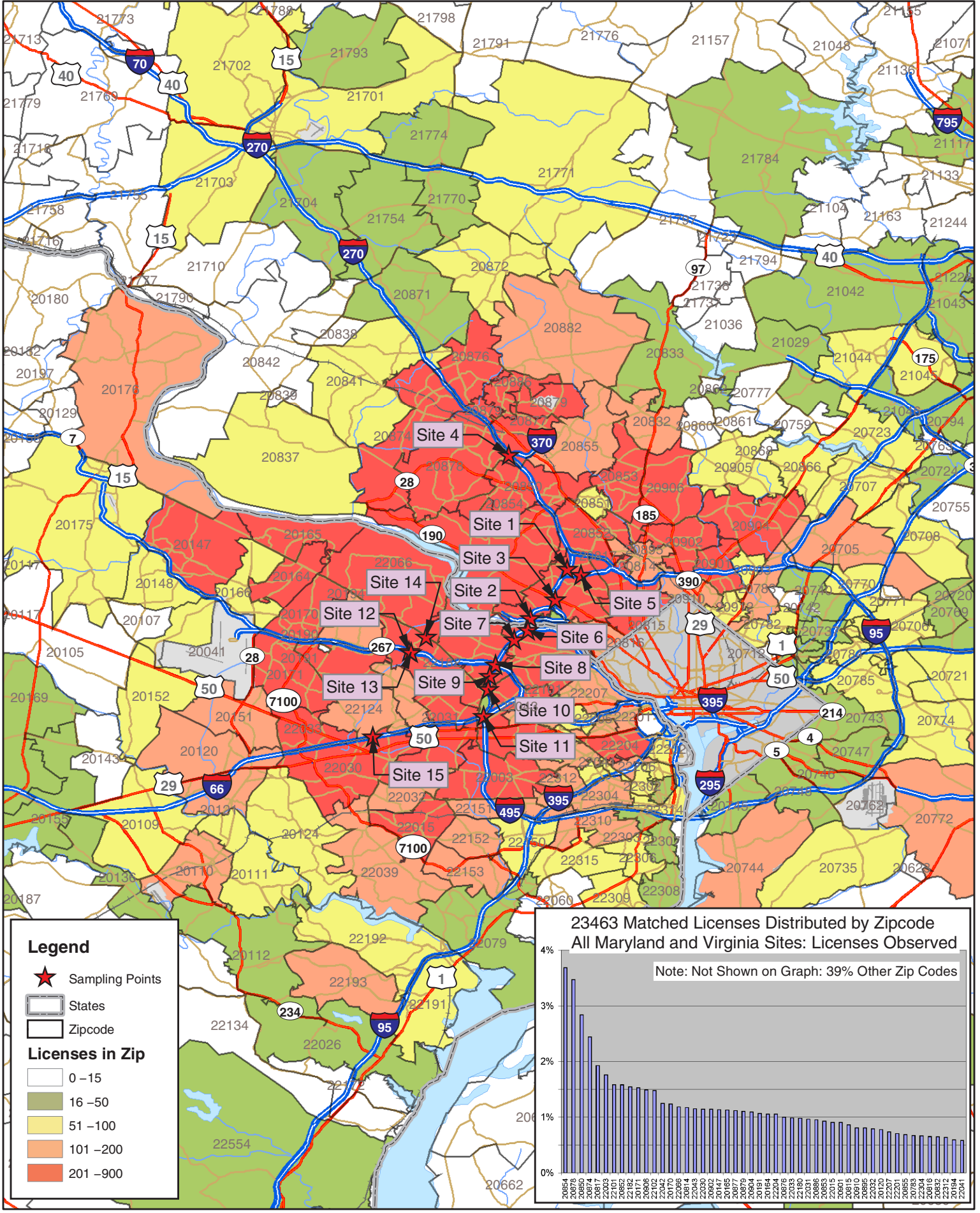


Vanasse Hangen Brustlin, Inc.

N

0 2.5 5 10 Miles

Figure 3–7
All Virginia Sites
MD Traffic Matched to Zip Codes
(Sites 6–15)



Vanasse Hangen Brustlin, Inc.

N

0 2.5 5 10 Miles

Figure 3-8
All Virginia & Maryland Sites
All Traffic Matched to Zip Codes
(Sites 1–15)

required external lighting and a large data collection team. From experience, reliability of human observation of license plate tags can be somewhat problematic.

For a corridor analysis, the zip code origins of the Maryland residents were grouped into the following corridors: Beltway Corridor, I-270 Corridor and the Frederick area via I-270. These Maryland Corridors were correlated with the Virginia sites east of the Beltway, westbound I-66 Corridor, westbound Dulles Corridor, and westbound Route 7. Table 3-6 summarizes these findings.

Table 3-6 Where Maryland Residents Head (6-9 AM commuter travel)

FROM: Area/ Corridor of residency	**# Tags** [a]	**TO: W. of Beltway [7W, 9W, 11, 12, 13, 14, 15 NOT thru 11]**	**Partial Detail of Some WB Destinations**			**TO: E. of Beltway (D.C. Core) [6,7E,8,9E,10]**
			TO: WB I-66 [11]	**TO: WB Dulles Corridor [12, 13]**	**TO: WB Rte 7 [14]**	
All MD codes	12,229	65% (7,929) [b]	11% (1,390)	23% (2,798)	3% (360)	35% (4,300)
Beltway Corridor	5,096	67% (3,425)	13% (670)	23% (1,160)	3% (134)	33% (1,671)
I-270 Corridor (excluding Frederick area)	5,022	55% (2,757)	10% (516)	19% (978)	2% (96)	45% (2,265)
Frederick area via I-270	461	25% (113)	4% (20)	4% (19)	2% (8)	75% (348)

[a] *Tags captured at Site 15also passing through Site 11 are not included in totals (to avoid double counting)*

[b] *Approximately 890 tags did not cross ALB (tags captured at Site 15 but not 11)*

[ ] *denotes sites included*

Table 3-6 shows that 65% of the Maryland residents traveling in Virginia during the commuting hours are oriented west of the Beltway and 35% are oriented east of the Beltway. Of the Maryland residents from the Maryland Beltway corridor, 67% are oriented to the west of the Beltway in Virginia and 33% are oriented east of the Beltway in Virginia. From the Maryland I-270 Corridor, 55% are oriented west of the Virginia Beltway and 45% east of the Beltway. From the Frederick area, 25% of the Maryland travelers are oriented west of the Beltway while 75% are oriented east of the Beltway.

The sector (see **Figure 3-4**) analysis approach for the 12,229 Maryland residents traveling to Virginia shows:

From Maryland West (5,641 vehicles identified)
- To Virginia West: 2,954 (52%)
- To Virginia East: 2,687 (48%)

From Maryland East (6,588 vehicles identified)
- To Virginia West: 4,975 (76%)
- To Virginia East: 1,613 (24%)

4

Findings

The data collected at the 15 selected sites appears to provide a very good representation of the morning commuting patterns between Virginia and Maryland crossing the American Legion Bridge.

Utilization of infra-red cameras proved to be convenient with no impact on traffic from the data collection effort. This technique, along with the use of data collected under normal conditions (no adverse weather or traffic conditions), helped to ensure that a large amount of data was collected.

Travel from Virginia to Maryland

Of the 23,563 vehicles observed, 12,796 were found to be Virginia vehicles. Of the 12,796 observed Virginia vehicles, zip code matches were made to 11,783 or 92%. Based on these comparisons and the resultant high percentages, the data observations are felt to be representative of travel from Virginia to Maryland during the data collection period of 6:00 AM to 9:00 AM and are reasonable for use in analysis and in other studies.

Looking at Table 3-1, 54% of observed vehicles were from Virginia. If Site 4 observations that are over 8 miles from the American Legion Bridge are removed from the sample, 63% of the vehicles in Maryland near the American Legion Bridge are Virginia vehicles.

Comparing **Figure 3-1** to **Figure 3-2**, the origins of travel from Virginia to the east in Maryland are more concentrated than the travel to the west of I-495.

Figure 3-3 which is a composite of all Virginia travelers observed in Maryland, illustrates that zip codes west of I-495 and north of I-66 have the highest concentration of commuters destined for Maryland.

From Table 3-3, 63% (7,130) of all Virginia vehicles matched (11,234) were destined to the east or exited the Beltway and headed south in Maryland. About 23% of the license tags analyzed from the East-West Corridors (I-66 and Dulles Corridors) traveled toward I-270 corridor and almost 6% toward destinations in or north of Gaithersburg. The proportion of residents along the North-South corridors Routes

28/7100 and Route 15, who head toward the I-270 Corridor, are approximately 20 and 24% respectively.

When the data collected is analyzed by sectors (see **Figure 3-4**) the 11,234 Virginia vehicles traveled to Maryland in the following portions:

From Virginia West (6,775 vehicles identified)
- To Maryland West: 2,179 (32%)
- To Maryland East: 4,596 (68%)

From Virginia East (4,459 vehicles identified)
- To Maryland West: 1,925 (43%)
- To Maryland East: 2,534 (57%)

From Table 3-3, approximately 70% of the Virginia vehicles traveling westbound from Maryland Sites 1, 2W and 3W, originated west of the Beltway.

The highest single match between a Virginia zip code and a Maryland observation location was zip code 22003 (Annandale) and Maryland Site #5 (Bethesda).

Travel from Maryland to Virginia

Of the 35,553 vehicles observed at Sites 6 through 15, 13,632 (38%) were Maryland vehicles. Of the 13,632 Maryland vehicles observed, 12,896 zip code matches were made for a 95% sample. Based on these comparisons and resultant high percentages, the data observations are felt to be representative of travel from Maryland to Virginia during the data collection period of 6:00 AM to 9:00 AM and are reasonable for drawing conclusions and inferences.

Looking at Table 3-4, 38% of the observed vehicles at Virginia sites were from Maryland. This is lower than the observed Virginia plates at the Maryland locations (54%). However, the lower percentage can partially be explained by the increased distance that the Virginia sites are from the American Legion Bridge in comparison to the Maryland observation sites, which results in greater percentages of local Virginia commuters passing through the Maryland sites.

If only the sites contiguous with I-495 (Sites 6-11) are considered, the percentage of Maryland vehicles observed increases from 38% to 63% (see Table 3-4).

From Table 3-4, the volumes for westbound travel on the Dulles Toll Road – Site 12 (2,673 out of 9,030) and the Dulles Access Road – Site 13 (315 out of 1,023) both show that approximately 30% of the vehicles are Maryland vehicles.

Comparing **Figure 3-5**, travel from Maryland to the west of I-495 in Virginia, with **Figure 3-6**, travel to the east of I-495 in Virginia, shows that travel originates from similar Maryland zip codes regardless of the direction traveled after exiting I-495 in Virginia. However, travel to the west of I-495 in Virginia was 84% higher than to the east of I-495 (7,929 west matches vs 4,300 east matches).

Figure 3-7, Maryland vehicles matched at all Virginia sites, shows a heavy concentration of commuters coming from the I-270 corridor and north of I-495.

Table 3-6 reflects 12,229 Maryland vehicles observed of which 35% (4,300) travel toward the east of the Beltway while 65% (7,929) travel toward the west of the Beltway. Of the Maryland residents originating in the I-270 Corridor, 55% (2,757) travel to destinations west of the Beltway in Virginia.

When the data collected is analyzed by sectors (see Figure 3-4) the 12,229 Maryland vehicles that traveled to Virginia in the following proportions:

From Maryland West (5,641 vehicles identified)
- To Virginia West: 2,954 (52%)
- To Virginia East: 2,687 (48%)

From Maryland East (6,588 vehicles identified)
- To Virginia West: 4,975 (76%)
- To Virginia East: 1,613 (24%)

The highest single match between a Maryland zip code and a Virginia observation location was zip code 20854 (Potomac) and Virginia Site #6 (George Washington Parkway).

Overall

Figure 3-7, which is a plot of all matched traffic in Maryland and Virginia, illustrates that there is a concentration of commuters around I-495 and along the western radial routes (I-270 in Maryland and Route 7, the Dulles Toll and Access Roads, Route 50 and I-66 in Virginia) that utilize the American Legion Bridge between Maryland and Virginia during the morning commuting period of 6:00 AM to 9:00 AM.

The high percentage of observed commuters from the sites contiguous with I-495 on both sides of the Potomac River near the American Legion Bridge (63%), provides overwhelming evidence of commuting between Virginia and Maryland.

The statistics of 92% and 95% licenses matched versus observed for Maryland sites and Virginia sites respectively, provides assurance that the data is within an acceptable range for drawing inferences.

This study has met its stated purpose of identifying and quantifying current commuting patterns of Virginia and Maryland residents crossing the Potomac River via the American Legion Bridge.

Appendices

- Appendix A: Data Collection by Site by Lane
- Appendix B: Zip code Plots of Vehicle Owner for Vehicles Observed by Site

Appendix A — Data Collection by Site by Lane

Maryland Sites - Virginia License Plate Data Summary

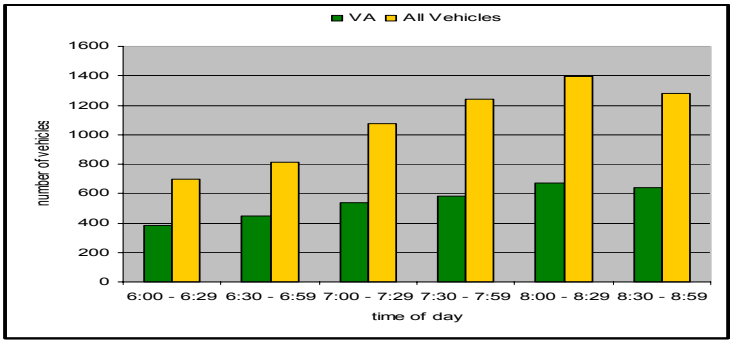
Site #	Virginia Vehicles	Total Vehicles	Virginia %
Site 1	3,260	6,499	50%
Site 2	2,188	2,952	74%
Site 3	1,585	2,285	69%
Site 4	918	4,672	20%
Site 5	4,845	7,155	68%
Totals	12,796	23,563	54.30%

Maryland Data Analysis

Total Vehicles & Virginia Vehicle % at Maryland Site 1 – I-270 at Westlake Terrace Bridge

6,499 Total Vehicles (3,260 Vehicles w/ Virginia License Plates) = 50.16%

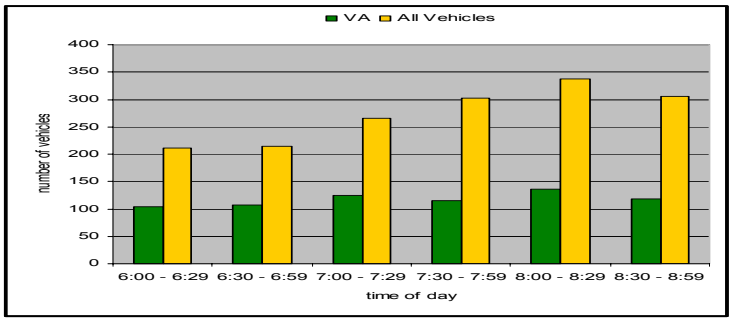
Site 1	VA	Total	VA%
6:00 - 6:29	384	695	55%
6:30 - 6:59	450	810	56%
7:00 - 7:29	536	1075	50%
7:30 - 7:59	583	1243	47%
8:00 - 8:29	670	1393	48%
8:30 - 8:59	637	1283	50%
Total	3260	6499	50%



Maryland Site 1 – Lane 1 North
Location: I-270 Spur NB at Westlake Terrace Bridge

1,638 Total Vehicles Lane 1 (706 Vehicles w/ Virginia License Plates) = 43%

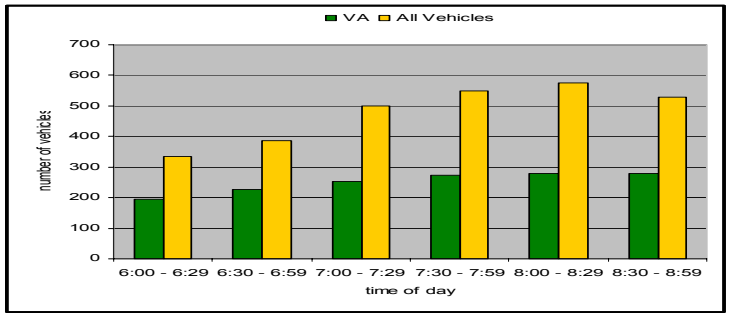
Site 1N1	VA	Total	VA %
6:00 - 6:29	104	212	49%
6:30 - 6:59	107	215	50%
7:00 - 7:29	125	265	47%
7:30 - 7:59	116	303	38%
8:00 - 8:29	136	338	40%
8:30 - 8:59	118	305	39%
Total	706	1638	43%



Maryland Site 1 – Lane 2 North
Location: I-270 Spur NB at Westlake Terrace Bridge

2,877 Total Vehicles Lane 2 (1,501 Vehicles w/ Virginia License Plates) = 52%

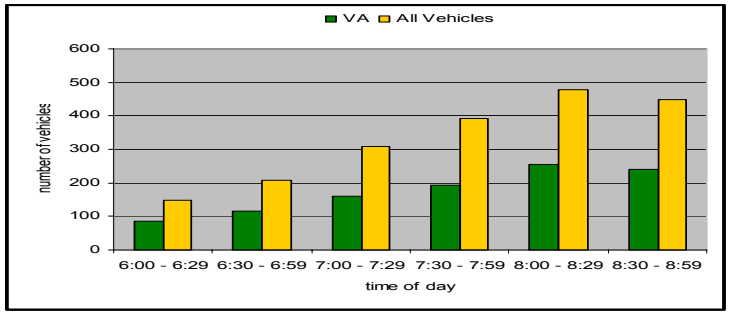
Site 1N2	VA	Total	VA %
6:00 - 6:29	194	334	58%
6:30 - 6:59	226	387	58%
7:00 - 7:29	252	501	50%
7:30 - 7:59	273	549	50%
8:00 - 8:29	278	576	48%
8:30 - 8:59	278	530	52%
Total	1501	2877	52%



Maryland Site 1 – Lane 3 North (HOV Lane)
Location: I-270 Spur NB at Westlake Terrace Bridge

1,984 Total Vehicles Lane 3 (1,053 Vehicles w/ Virginia License Plates) = 53%

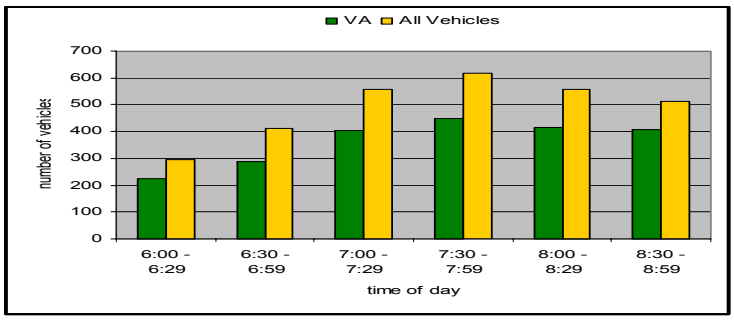
Site 1N3	VA	Total	VA %
6:00 - 6:29	86	149	58%
6:30 - 6:59	117	208	56%
7:00 - 7:29	159	309	51%
7:30 - 7:59	194	391	50%
8:00 - 8:29	256	479	53%
8:30 - 8:59	241	448	54%
Total	1053	1984	53%



Total Vehicles & Virginia Vehicle % at Maryland Site 2 – I-495 at Clara Barton Parkway

2,952 Total Vehicles (2,188 Vehicles w/ Virginia License Plates) = 74.11%

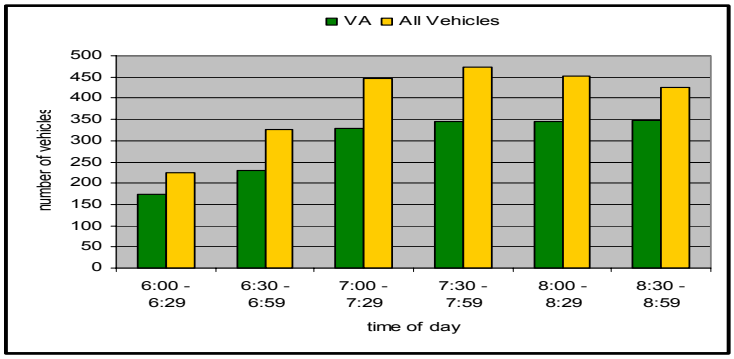
Site 2	VA	Total	VA %
6:00 - 6:29	223	297	75%
6:30 - 6:59	288	413	70%
7:00 - 7:29	404	556	73%
7:30 - 7:59	449	617	73%
8:00 - 8:29	416	556	74%
8:30 - 8:59	408	513	80%
Total	2188	2952	74%



Maryland Site 2 – Lane 1 East
Location: Clara Barton Parkway Off-Ramp EB at I-495 NB

2,346 Total Vehicles (1,774 Vehicles w/ Virginia License Plates) = 76%

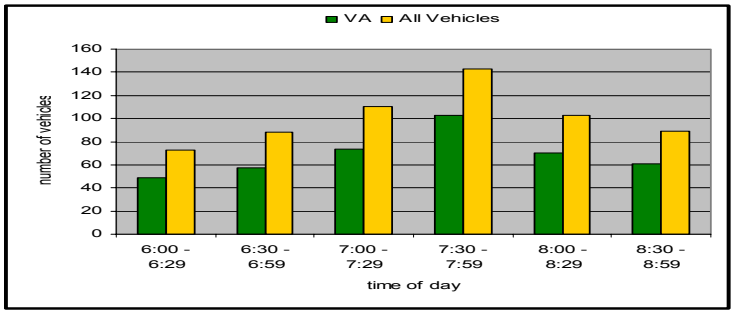
Site 2E1	VA	Total	VA %
6:00 - 6:29	174	224	78%
6:30 - 6:59	231	325	71%
7:00 - 7:29	330	446	74%
7:30 - 7:59	346	474	73%
8:00 - 8:29	346	453	76%
8:30 - 8:59	347	424	82%
Total	1774	2346	76%



Maryland Site 2 – Lane 1 West
Location: Clara Barton Parkway Off-Ramp WB at I-495 NB

606 Total Vehicles (414 Vehicles w/ Virginia License Plates) = 68%

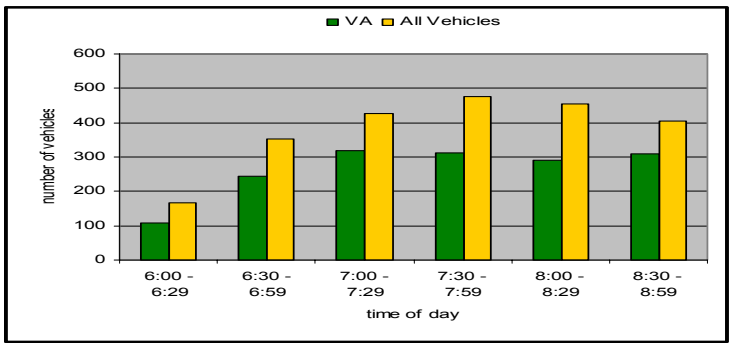
Site 2W1	VA	Total	VA %
6:00 - 6:29	49	73	67%
6:30 - 6:59	57	88	65%
7:00 - 7:29	74	110	67%
7:30 - 7:59	103	143	72%
8:00 - 8:29	70	103	68%
8:30 - 8:59	61	89	69%
Total	414	606	68%



Total Vehicles & Virginia Vehicle % at Maryland Site 3 – I-495 at River Road

2,285 Total Vehicles (1,585 Vehicles w/ Virginia License Plates) = 69.36%

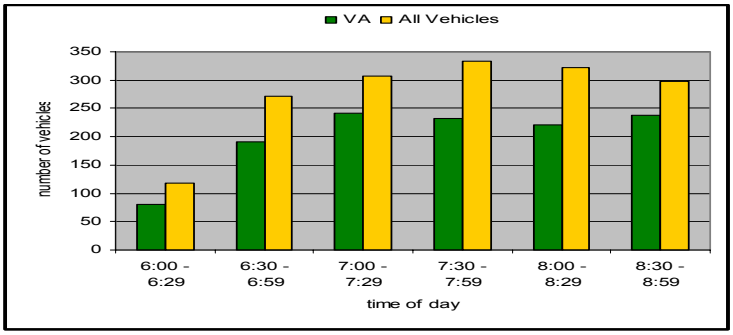
Site 3	VA	Total	VA %
6:00 - 6:29	109	166	66%
6:30 - 6:59	245	354	69%
7:00 - 7:29	319	427	75%
7:30 - 7:59	312	477	65%
8:00 - 8:29	291	455	64%
8:30 - 8:59	309	406	76%
Total	1585	2285	69%



Maryland Site 3 – Lane 1 East
Location: River Road Off-Ramp EB at I-495 NB

1,649 Total Vehicles (1,203 Vehicles w/ Virginia License Plates) = 73%

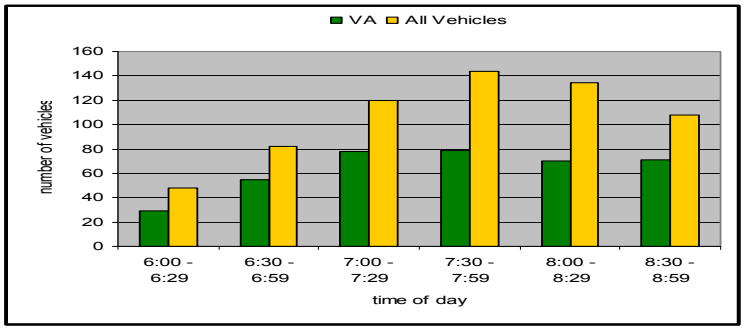
Site 3E1	VA	Total	VA %
6:00 - 6:29	80	118	68%
6:30 - 6:59	190	272	70%
7:00 - 7:29	241	307	79%
7:30 - 7:59	233	333	70%
8:00 - 8:29	221	321	69%
8:30 - 8:59	238	298	80%
Total	1203	1649	73%



Maryland Site 3 – Lane 1 West
Location: River Road Off-Ramp WB at I-495 NB

636 Total Vehicles (382 Vehicles w/ Virginia License Plates) = 60%

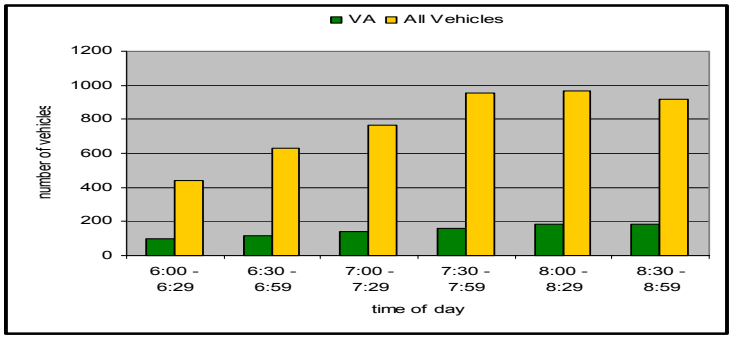
Site 3W1	VA	Total	VA %
6:00 - 6:29	29	48	60%
6:30 - 6:59	55	82	67%
7:00 - 7:29	78	120	65%
7:30 - 7:59	79	144	55%
8:00 - 8:29	70	134	52%
8:30 - 8:59	71	108	66%
Total	382	636	60%



Total Vehicles & Virginia Vehicle % at Maryland Site 4 – I-270 at Sam Eig Hwy Bridge

4,672 Total Vehicles (918 Vehicles w/ Virginia License Plates) = 19.65%

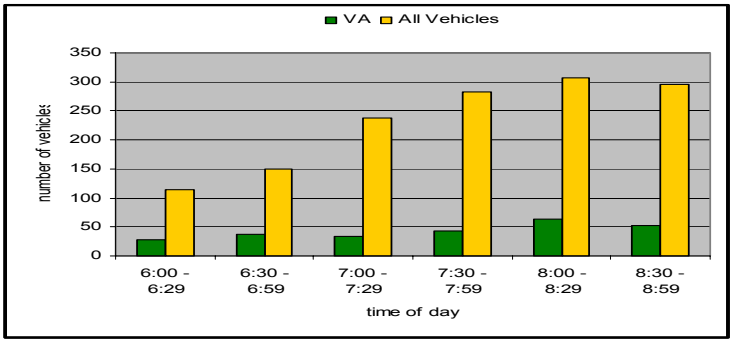
Site 4	VA	Total	VA %
6:00 - 6:29	99	439	23%
6:30 - 6:59	114	630	18%
7:00 - 7:29	141	763	18%
7:30 - 7:59	159	957	17%
8:00 - 8:29	185	965	19%
8:30 - 8:59	182	918	20%
Total	918	4672	20%



Maryland Site 4 – Lane 1 North
Location: I-270 Mainline NB at Same Eig Highway Bridge

1,388 Total Vehicles (258 Vehicles w/ Virginia License Plates) = 19%

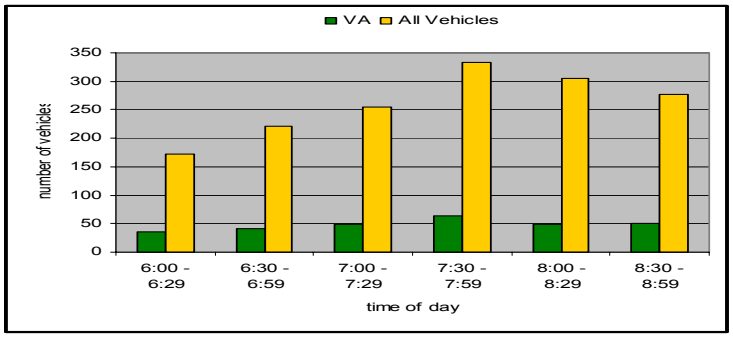
Site 4N1	VA	Total	VA %
6:00 - 6:29	28	115	24%
6:30 - 6:59	37	150	25%
7:00 - 7:29	34	237	14%
7:30 - 7:59	43	283	15%
8:00 - 8:29	63	307	21%
8:30 - 8:59	53	296	18%
Total	258	1388	19%



Maryland Site 4 – Lane 2 North
Location: I-270 Mainline NB at Same Eig Highway Bridge

1,563 Total Vehicles (291 Vehicles w/ Virginia License Plates) = 19%

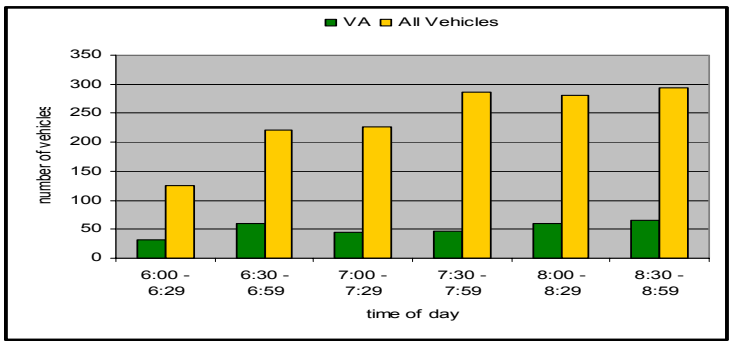
Site 4N2	VA	Total	VA %
6:00 - 6:29	36	172	21%
6:30 - 6:59	42	220	19%
7:00 - 7:29	49	255	19%
7:30 - 7:59	64	333	19%
8:00 - 8:29	49	306	16%
8:30 - 8:59	51	277	18%
Total	291	1563	19%



Maryland Site 4 – Lane 3 North
Location: I-270 Mainline NB at Same Eig Highway Bridge

1,436 Total Vehicles (309 Vehicles w/ Virginia License Plates) = 22%

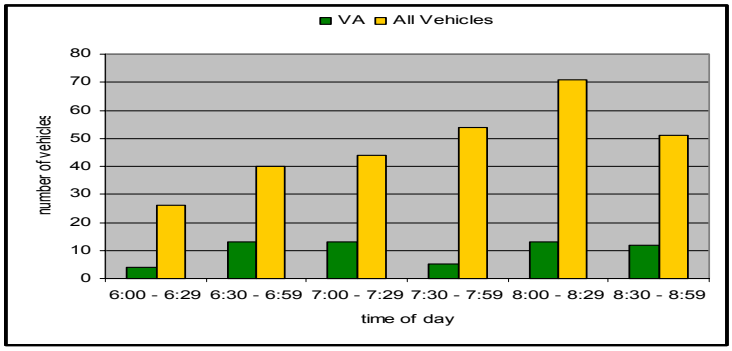
Site 4N3	VA	Total	VA %
6:00 - 6:29	31	126	25%
6:30 - 6:59	60	220	27%
7:00 - 7:29	45	227	20%
7:30 - 7:59	47	287	16%
8:00 - 8:29	60	281	21%
8:30 - 8:59	66	294	22%
Total	309	1436	22%



Maryland Site 4 – Lane 4 North (HOV Lane)
Location: I-270 Mainline NB at Sam Eig Highway Bridge

286 Total Vehicles (60 Vehicles w/ Virginia License Plates) = 21%

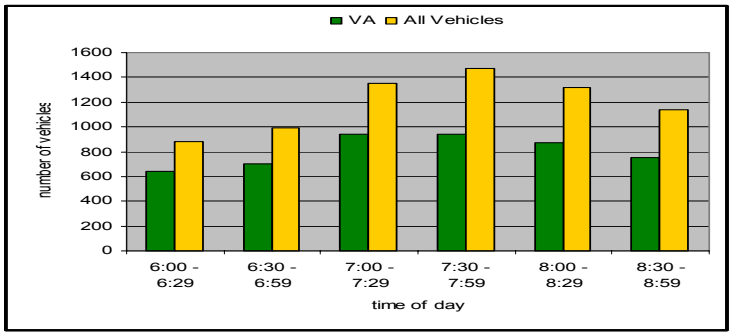
Site 4N4	VA	Total	VA %
6:00 - 6:29	4	26	15%
6:30 - 6:59	13	40	33%
7:00 - 7:29	13	44	30%
7:30 - 7:59	5	54	9%
8:00 - 8:29	13	71	18%
8:30 - 8:59	12	51	24%
Total	60	286	21%



Total Vehicles & Virginia Vehicle % at Maryland Site 5 – I-495 at Green Tree Road Bridge

7,155 Total Vehicles (4,845 Vehicles w/ Virginia License Plates) = 67.71%

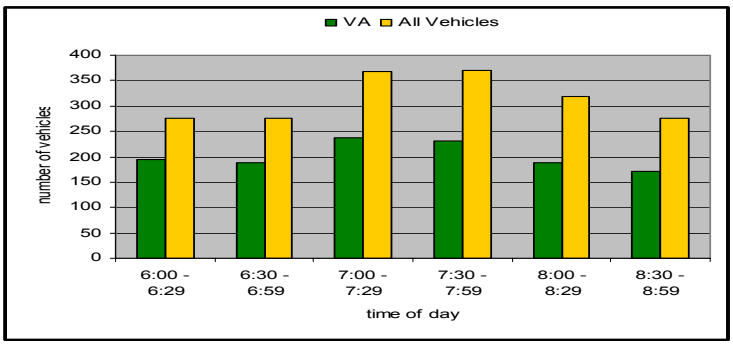
Site 5	**VA**	**Total**	**VA %**
6:00 - 6:29	**638**	**879**	**73%**
6:30 - 6:59	**704**	**995**	**71%**
7:00 - 7:29	**939**	**1356**	**69%**
7:30 - 7:59	**941**	**1472**	**64%**
8:00 - 8:29	**871**	**1319**	**66%**
8:30 - 8:59	**752**	**1134**	**66%**
Total	**4845**	**7155**	**68%**



Maryland Site 5 – Lane 1 East
Location: I-495 Mainline EB at Green Tree Road Bridge

1,885 Total Vehicles (1,210 Vehicles w/ Virginia License Plates) = 64%

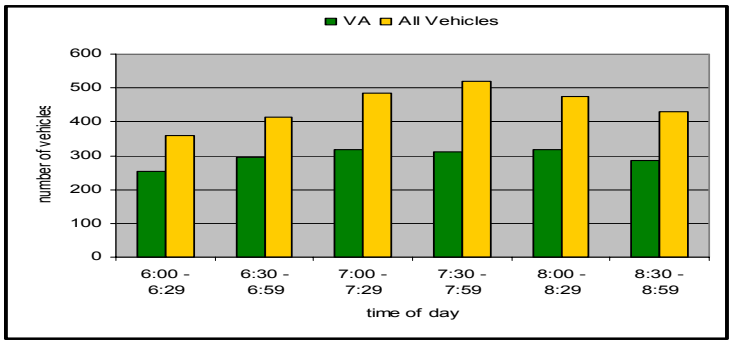
Site 5E1	VA	Total	VA %
6:00 - 6:29	195	275	71%
6:30 - 6:59	189	277	68%
7:00 - 7:29	237	367	65%
7:30 - 7:59	230	371	62%
8:00 - 8:29	188	319	59%
8:30 - 8:59	171	276	62%
Total	1210	1885	64%



Maryland Site 5 – Lane 2 East
Location: I-495 Mainline EB at Green Tree Road Bridge

2,682 Total Vehicles (1,778 Vehicles w/ Virginia License Plates) = 66%

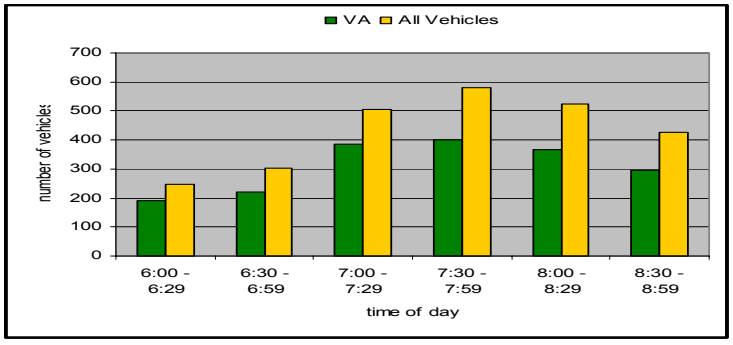
Site 5E2	VA	Total	VA %
6:00 - 6:29	252	358	70%
6:30 - 6:59	294	414	71%
7:00 - 7:29	317	485	65%
7:30 - 7:59	312	519	60%
8:00 - 8:29	318	476	67%
8:30 - 8:59	285	430	66%
Total	1778	2682	66%



Maryland Site 5 – Lane 3 East
Location: I-495 Mainline EB at Green Tree Road Bridge

2,588 Total Vehicles (1,857 Vehicles w/ Virginia License Plates) = 72%

Site 5E3	VA	Total	VA %
6:00 - 6:29	191	246	78%
6:30 - 6:59	221	304	73%
7:00 - 7:29	385	504	76%
7:30 - 7:59	399	582	69%
8:00 - 8:29	365	524	70%
8:30 - 8:59	296	428	69%
Total	1857	2588	72%



Virginia Sites – Maryland License Plate Data Summary

Site #	Maryland Vehicles	Total Vehicles	Maryland %
Site 6	2,837	4,254	67%
Site 7	1,325	1,915	69%
Site 8	412	628	66%
Site 9	2,127	3,212	66%
Site 10	431	841	51%
Site 11	1,469	2,726	54%
Site 12	2,673	9,030	30%
Site 13	315	1,023	31%
Site 14	379	2,732	14%
Site 15	1,664	9,192	18%
Totals	13,632	35,551	38.34%

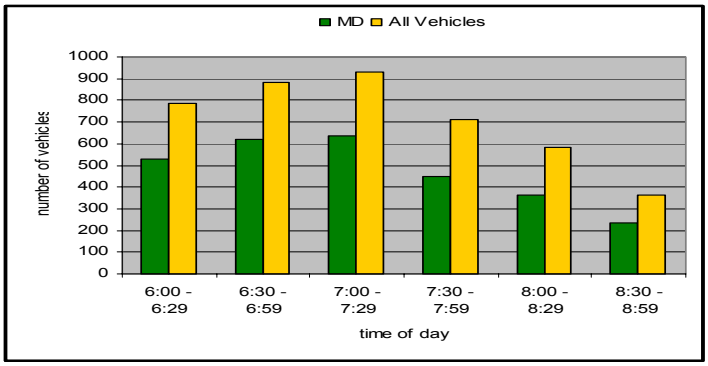
Virginia Data Analysis

Total Vehicles & Maryland Vehicle % at Virginia Site 6 – I-495 at George Washington Pkwy

4,254 Total Vehicles (2,837 Vehicles w/ Maryland License Plates) = 66.69%

Virginia Site 6 – Lane 1 East
Location: George Washington Pkwy Off-Ramp EB at I-495 SB

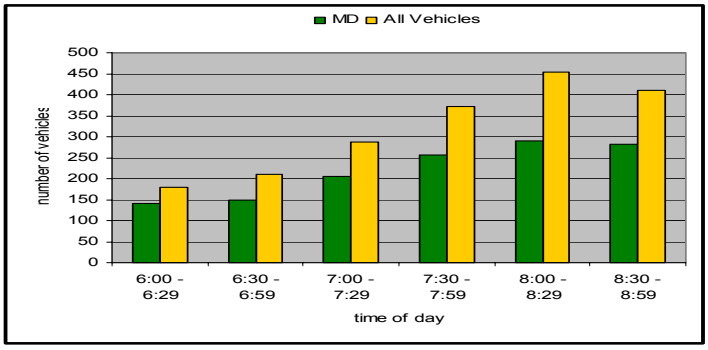
Site 6	MD	Total	MD %
6:00 - 6:29	527	785	67%
6:30 - 6:59	621	882	70%
7:00 - 7:29	638	931	69%
7:30 - 7:59	450	711	63%
8:00 - 8:29	366	584	63%
8:30 - 8:59	235	361	65%
Total	2837	4254	67%



Total Vehicles & Maryland Vehicle % at Virginia Site 7 – I-495 at Georgetown Pike

1,915 Total Vehicles (1,325 Vehicles w/ Maryland License Plates) = 69.19%

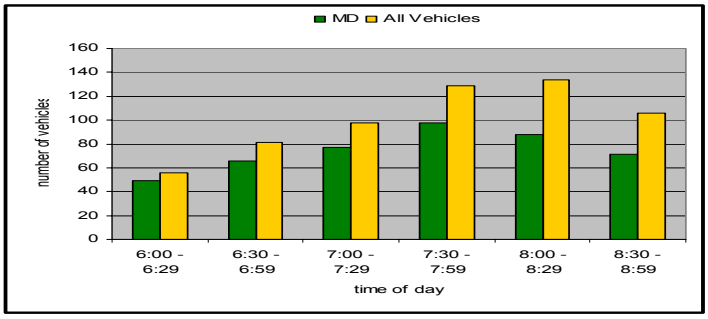
Site 7	MD	Total	MD %
6:00 - 6:29	141	180	78%
6:30 - 6:59	150	210	71%
7:00 - 7:29	206	288	71%
7:30 - 7:59	257	372	69%
8:00 - 8:29	290	455	64%
8:30 - 8:59	281	410	68%
Total	1325	1915	69%



Virginia Site 7 – Lane 1 East
Location: Georgetown Pike Off-Ramp EB at I-495 SB

604 Total Vehicles (449 Vehicles w/ Maryland License Plates) = 74%

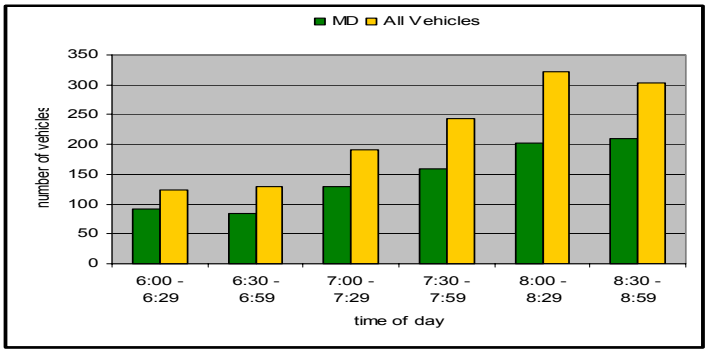
Site 7E1	MD	Total	MD %
6:00 - 6:29	49	56	88%
6:30 - 6:59	66	81	81%
7:00 - 7:29	77	98	79%
7:30 - 7:59	98	129	76%
8:00 - 8:29	88	134	66%
8:30 - 8:59	71	106	67%
Total	449	604	74%



Virginia Site 7 – Lane 1 West
Location: Georgetown Pike Off-Ramp WB at I-495 SB

1,311 Total Vehicles (876 Vehicles w/ Maryland License Plates) = 67%

Site 7W1	MD	Total	MD %
6:00 - 6:29	92	124	74%
6:30 - 6:59	84	129	65%
7:00 - 7:29	129	190	68%
7:30 - 7:59	159	243	65%
8:00 - 8:29	202	321	63%
8:30 - 8:59	210	304	69%
Total	876	1311	67%

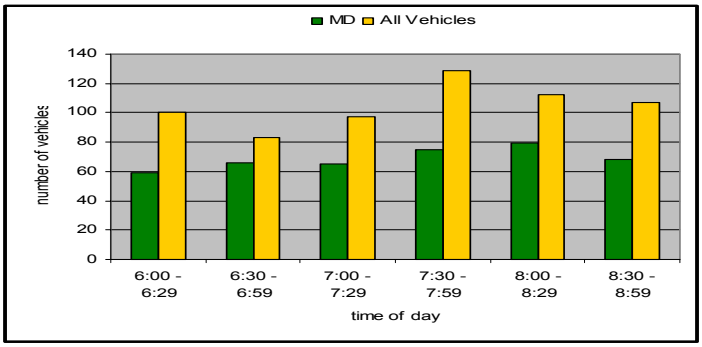


Total Vehicles & Maryland Vehicle % at Virginia Site 8 – I-495 / Dulles Toll Road to I-66 East

628 Total Vehicles (412 Vehicles w/ Maryland License Plates) = 65.60%

Virginia Site 8 – Lane 1 East
Location: I-495 SB / Dulles Toll Road to I-66 EB

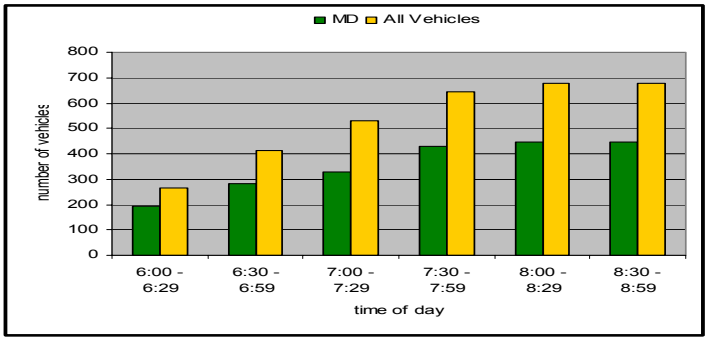
Site 8	MD	Total	MD %
6:00 - 6:29	59	100	59%
6:30 - 6:59	66	83	80%
7:00 - 7:29	65	97	67%
7:30 - 7:59	75	129	58%
8:00 - 8:29	79	112	71%
8:30 - 8:59	68	107	64%
Total	412	628	66%



Total Vehicles & Maryland Vehicle % at Virginia Site 9 – I-495 at Chain Bridge Road

3,212 Total Vehicles (2,127 Vehicles w/ Maryland License Plates) = 66.22%

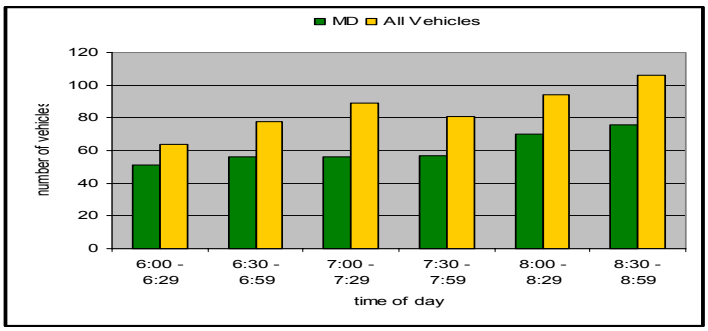
Site 9	MD	Total	MD %
6:00 - 6:29	194	267	73%
6:30 - 6:59	282	411	69%
7:00 - 7:29	327	531	62%
7:30 - 7:59	429	644	67%
8:00 - 8:29	448	680	69%
8:30 - 8:59	447	679	72%
Total	2127	3212	66%



Virginia Site 9 – Lane 1 East
Chain Bridge Road Off-Ramp EB at I-495 SB

512 Total Vehicles (366 Vehicles w/ Maryland License Plates) = 71%

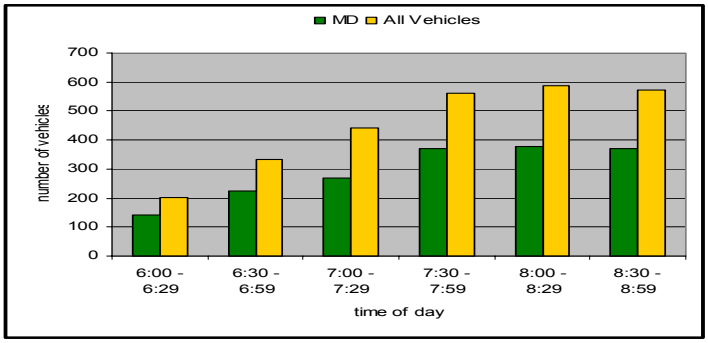
Site 9E1	MD	Total	MD %
6:00 - 6:29	51	64	80%
6:30 - 6:59	56	78	72%
7:00 - 7:29	56	89	63%
7:30 - 7:59	57	81	70%
8:00 - 8:29	70	94	74%
8:30 - 8:59	76	106	72%
Total	366	512	71%



Virginia Site 9 – Lane 1 West
Location: Chain Bridge Road Off-Ramp WB at I-495 SB

2,700 Total Vehicles (1761 Vehicles w/ Maryland License Plates) = 65%

Site 9W1	MD	Total	MD %
6:00 - 6:29	143	203	70%
6:30 - 6:59	226	333	68%
7:00 - 7:29	271	442	61%
7:30 - 7:59	372	563	66%
8:00 - 8:29	378	586	65%
8:30 - 8:59	371	573	65%
Total	1761	2700	65%

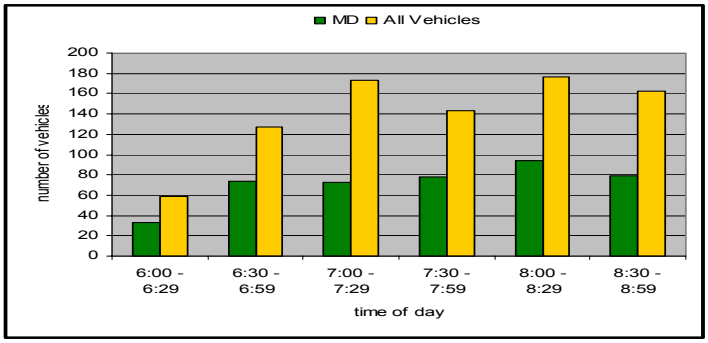


Total Vehicles & Maryland Vehicle % at Virginia Site 10 – I-495 at Leesburg Pike

841 Total Vehicles (431 Vehicles w/ Maryland License Plates) = 51.25%

Virginia Site 10 – Lane 1 East
Location: Leesburg Pike Off-Ramp EB at I-495 SB

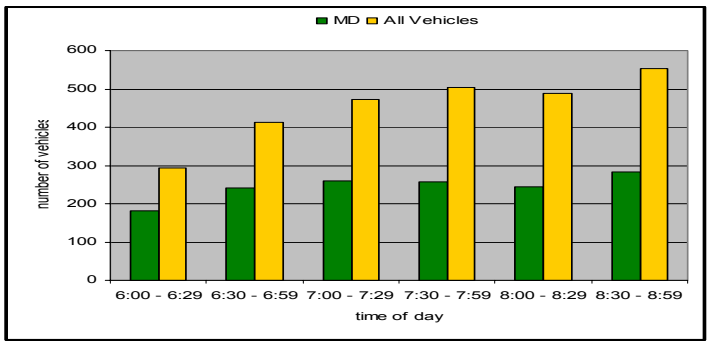
Site 10	**MD**	**Total**	**MD %**
6:00 - 6:29	**33**	**59**	**56%**
6:30 - 6:59	**74**	**127**	**58%**
7:00 - 7:29	**73**	**173**	**42%**
7:30 - 7:59	**78**	**143**	**55%**
8:00 - 8:29	**94**	**176**	**53%**
8:30 - 8:59	**79**	**163**	**48%**
Total	**431**	**841**	**51%**



Total Vehicles & Maryland Vehicle % at Virginia Site 11 – I-495 Mainline to I-66 West

2726 Total Vehicles (1469 Vehicles w/ Maryland License Plates) = 53.89%

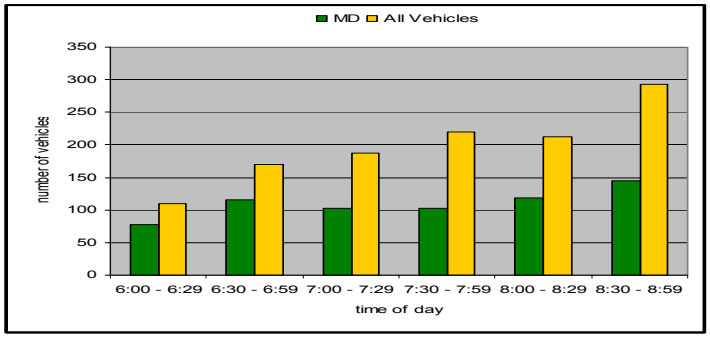
Site 11	MD	Total	MD %
6:00 - 6:29	183	294	62%
6:30 - 6:59	242	414	58%
7:00 - 7:29	261	472	55%
7:30 - 7:59	256	503	51%
8:00 - 8:29	245	489	50%
8:30 - 8:59	282	554	51%
Total	1469	2726	54%



Virginia Site 11 – Lane 1 West
Location: I-495 Mainline Off-Ramp SB to I-66 Mainline WB

1,193 Total Vehicles (663 Vehicles w/ Maryland License Plates) = 56%

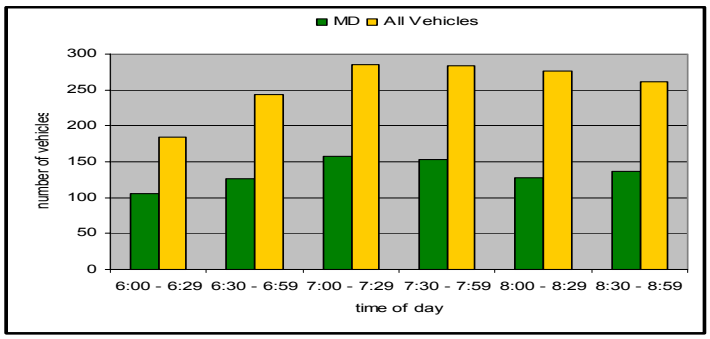
Site 11W1	MD	Total	MD %
6:00 - 6:29	78	110	71%
6:30 - 6:59	116	170	68%
7:00 - 7:29	103	187	55%
7:30 - 7:59	103	220	47%
8:00 - 8:29	118	213	55%
8:30 - 8:59	145	293	49%
Total	663	1193	56%



Virginia Site 11 – Lane 2 West
Location: I-495 Mainline Off-Ramp SB to I-66 Mainline WB

1,533 Total Vehicles (806 Vehicles w/ Maryland License Plates) = 53%

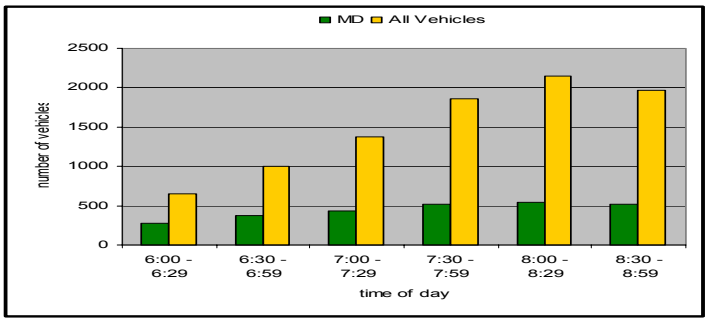
Site 11W2	MD	Total	MD %
6:00 - 6:29	105	184	57%
6:30 - 6:59	126	244	52%
7:00 - 7:29	158	285	55%
7:30 - 7:59	153	283	54%
8:00 - 8:29	127	276	46%
8:30 - 8:59	137	261	52%
Total	806	1533	53%



Total Vehicles & Maryland Vehicle % at Virginia Site 12 – Dulles Toll Road at Trap Road

9,030 Total Vehicles (2,673 Vehicles w/ Maryland License Plates) = 29.60%

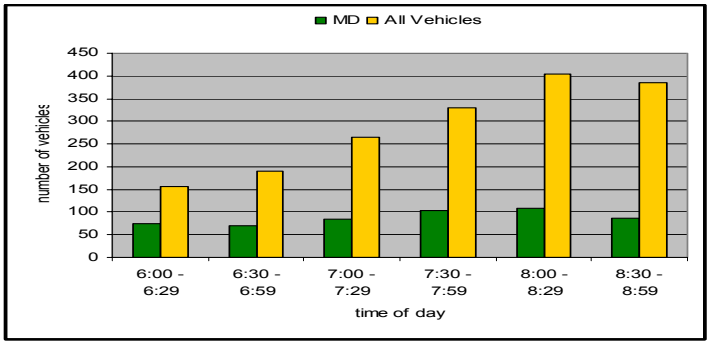
Site 12	MD	Total	MD %
6:00 - 6:29	282	656	43%
6:30 - 6:59	378	1008	38%
7:00 - 7:29	438	1378	32%
7:30 - 7:59	515	1865	28%
8:00 - 8:29	542	2150	25%
8:30 - 8:59	518	1973	26%
Total	2673	9030	30%



Virginia Site 12 – Lane 1 West
Location: Dulles Toll Road WB at Trap Road Bridge

1,728 Total Vehicles (527 Vehicles w/ Maryland License Plates) = 30%

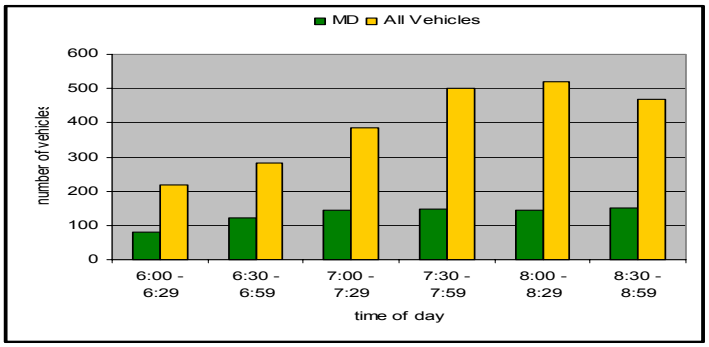
Site 12W1	MD	Total	MD %
6:00 - 6:29	75	156	48%
6:30 - 6:59	69	189	37%
7:00 - 7:29	85	264	32%
7:30 - 7:59	103	330	31%
8:00 - 8:29	108	405	27%
8:30 - 8:59	87	384	23%
Total	527	1728	30%



Virginia Site 12 – Lane 2 West
Location: Dulles Toll Road WB at Trap Road Bridge

2,376 Total Vehicles (786 Vehicles w/ Maryland License Plates) = 33%

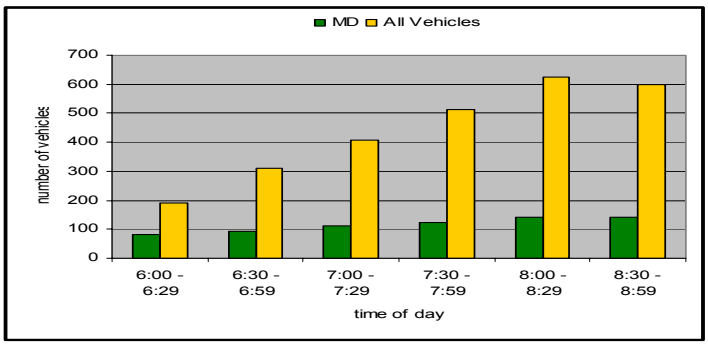
Site 12W2	MD	Total	MD %
6:00 - 6:29	80	219	37%
6:30 - 6:59	122	283	43%
7:00 - 7:29	143	386	37%
7:30 - 7:59	146	500	29%
8:00 - 8:29	145	520	28%
8:30 - 8:59	150	468	32%
Total	786	2376	33%



Virginia Site 12 – Lane 3 West
Location: Dulles Toll Road WB at Trap Road Bridge

2,646 Total Vehicles (696 Vehicles w/ Maryland License Plates) = 26%

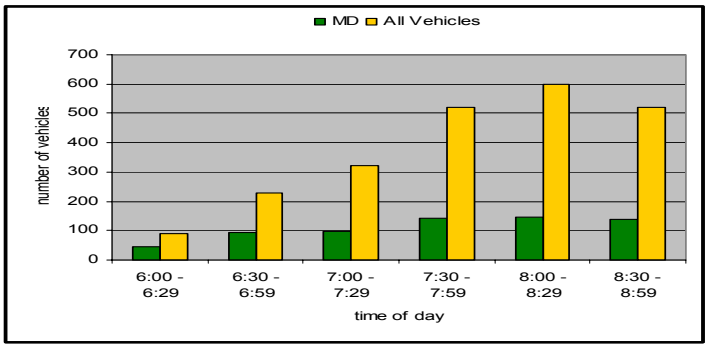
Site 12W3	MD	Total	MD %
6:00 - 6:29	81	190	43%
6:30 - 6:59	92	309	30%
7:00 - 7:29	114	407	28%
7:30 - 7:59	122	514	24%
8:00 - 8:29	143	626	23%
8:30 - 8:59	144	600	24%
Total	696	2646	26%



Virginia Site 12 – Lane 4 West
Location: Dulles Toll Road WB at Trap Road Bridge

2,280 Total Vehicles (664 Vehicles w/ Maryland License Plates) = 29%

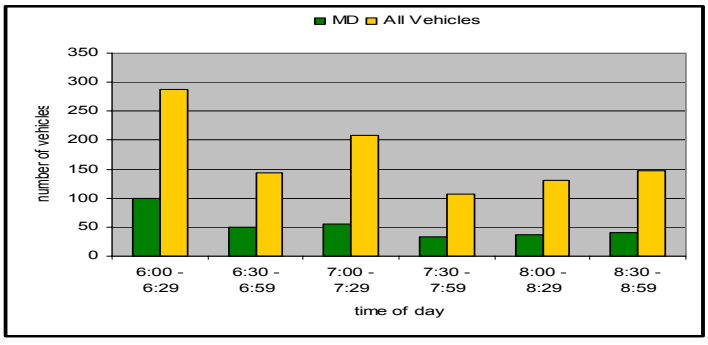
Site 12W4	MD	Total	MD %
6:00 - 6:29	46	91	51%
6:30 - 6:59	95	227	42%
7:00 - 7:29	96	321	30%
7:30 - 7:59	144	521	28%
8:00 - 8:29	146	599	24%
8:30 - 8:59	137	521	26%
Total	664	2280	29%



Total Vehicles & Maryland Vehicle % at Virginia Site 13 – Dulles Access Road at Trap Road

1,023 Total Vehicles (315 Vehicles w/ Maryland License Plates) = 30.79%

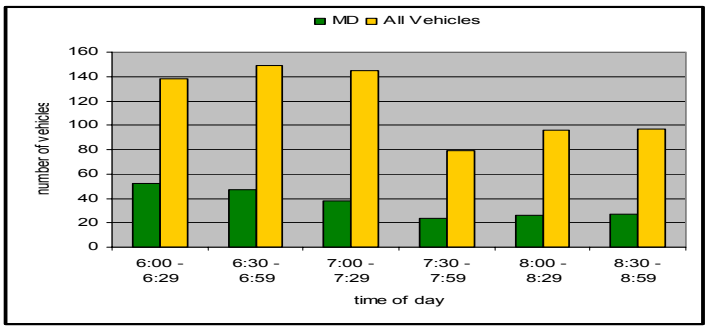
Site 13	**MD**	**Total**	**MD %**
6:00 - 6:29	**99**	**287**	**34%**
6:30 - 6:59	**49**	**143**	**34%**
7:00 - 7:29	**55**	**209**	**26%**
7:30 - 7:59	**34**	**106**	**32%**
8:00 - 8:29	**37**	**131**	**28%**
8:30 - 8:59	**41**	**147**	**28%**
Total	**315**	**1023**	**31%**



Virginia Site 13 – Lane 1 West
Location: Dulles Access Road WB at Trap Road Bridge

704 Total Vehicles (214 Vehicles w/ Maryland License Plates) = 30%

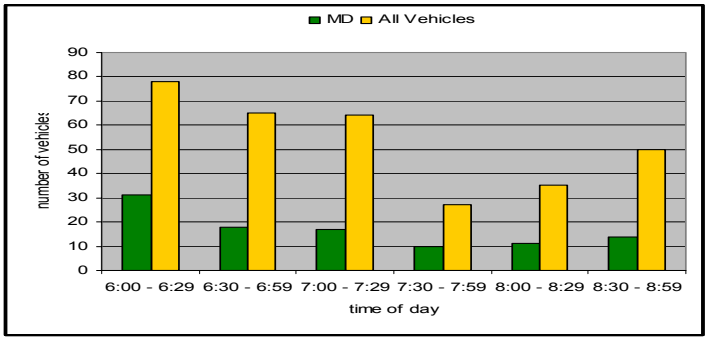
Site 13W1	MD	Total	MD %
6:00 - 6:29	52	138	38%
6:30 - 6:59	47	149	32%
7:00 - 7:29	38	145	26%
7:30 - 7:59	24	79	30%
8:00 - 8:29	26	96	27%
8:30 - 8:59	27	97	28%
Total	214	704	30%



Virginia Site 13 – Lane 2 West
Location: Dulles Access Road WB at Trap Road Bridge

319 Total Vehicles (101 Vehicles w/ Maryland License Plates) = 32%

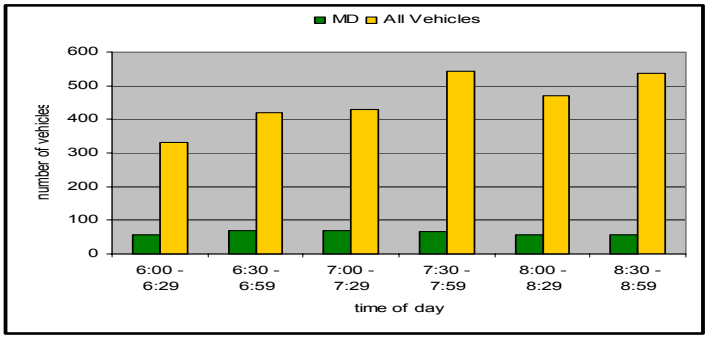
Site 13W2	MD	Total	MD %
6:00 - 6:29	31	78	40%
6:30 - 6:59	18	65	28%
7:00 - 7:29	17	64	27%
7:30 - 7:59	10	27	37%
8:00 - 8:29	11	35	31%
8:30 - 8:59	14	50	28%
Total	101	319	32%



Total Vehicles & Maryland Vehicle % at Virginia Site 14 – Leesburg Pike West of Toll Road

2,732 Total Vehicles (379 Vehicles w/ Maryland License Plates) = 13.87%

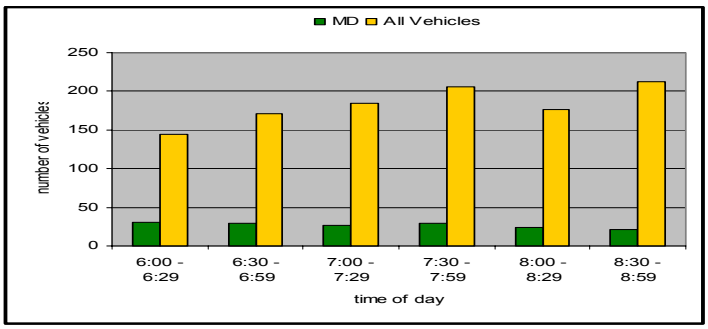
Site 14	**MD**	**Total**	**MD %**
6:00 - 6:29	**58**	**332**	**17%**
6:30 - 6:59	**71**	**420**	**17%**
7:00 - 7:29	**69**	**431**	**16%**
7:30 - 7:59	**66**	**542**	**12%**
8:00 - 8:29	**58**	**470**	**12%**
8:30 - 8:59	**57**	**537**	**11%**
Total	**379**	**2732**	**14%**



Virginia Site 14 – Lane 1 West
Location: Leesburg Pike West of Dulles Toll Road WB

1,096 Total Vehicles (164 Vehicles w/ Maryland License Plates) = 15%

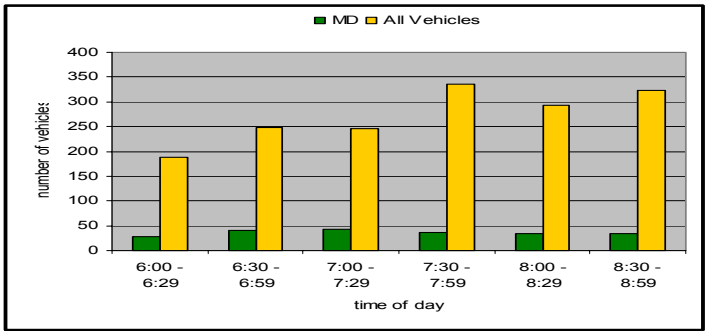
Site 14W1	MD	Total	MD %
6:00 - 6:29	31	144	22%
6:30 - 6:59	30	171	18%
7:00 - 7:29	27	185	15%
7:30 - 7:59	30	206	15%
8:00 - 8:29	24	177	14%
8:30 - 8:59	22	213	10%
Total	164	1096	15%



Virginia Site 14 – Lane 2 West
Location: Leesburg Pike West of Dulles Toll Road WB

1,636 Total Vehicles (215 Vehicles w/ Maryland License Plates) = 13%

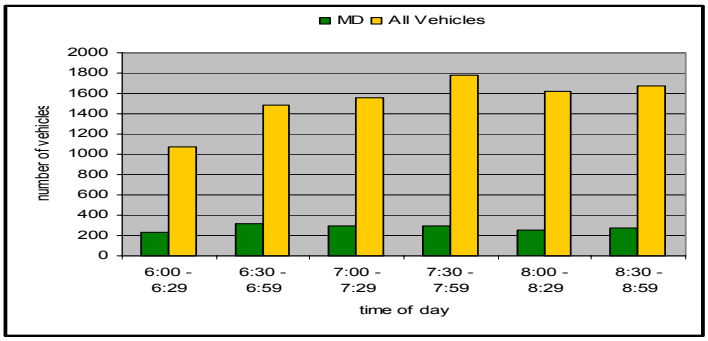
Site 14W2	MD	Total	MD %
6:00 - 6:29	27	188	14%
6:30 - 6:59	41	249	16%
7:00 - 7:29	42	246	17%
7:30 - 7:59	36	336	11%
8:00 - 8:29	34	293	12%
8:30 - 8:59	35	324	11%
Total	215	1636	13%



Total Vehicles & Maryland Vehicle % at Virginia Site 15 – I-66 West at Jermantown Road

9,192 Total Vehicles (1,664 Vehicles w/ Maryland License Plates) = 18.10%

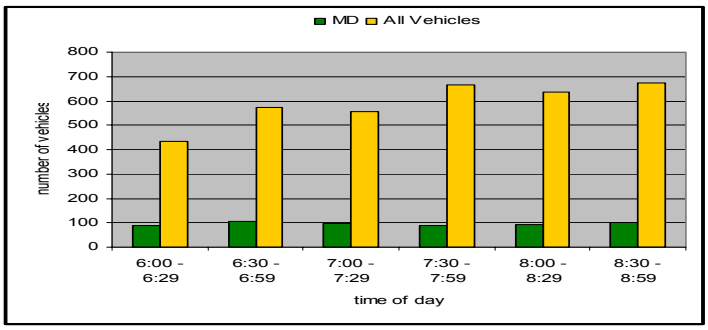
Site 15	**MD**	**Total**	**MD %**
6:00 - 6:29	**231**	**1074**	**22%**
6:30 - 6:59	**312**	**1485**	**21%**
7:00 - 7:29	**298**	**1558**	**19%**
7:30 - 7:59	**295**	**1774**	**17%**
8:00 - 8:29	**253**	**1625**	**16%**
8:30 - 8:59	**275**	**1676**	**16%**
Total	**1664**	**9192**	**18%**



Virginia Site 15 – Lane 1 West
Location: I-66 Mainline WB at Jermantown Road Bridge

3,537 Total Vehicles (568 Vehicles w/ Maryland License Plates = 16%

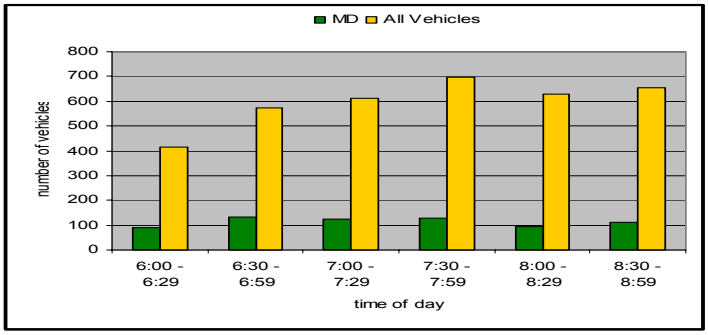
Site 15W1	MD	Total	MD %
6:00 - 6:29	89	432	21%
6:30 - 6:59	104	572	18%
7:00 - 7:29	95	557	17%
7:30 - 7:59	90	665	14%
8:00 - 8:29	91	636	14%
8:30 - 8:59	99	675	15%
Total	568	3537	16%



Virginia Site 15 – Lane 2 West
Location: I-66 Mainline WB at Jermantown Road Bridge

3,582 Total Vehicles (677 Vehicles w/ Maryland License Plates) = 19%

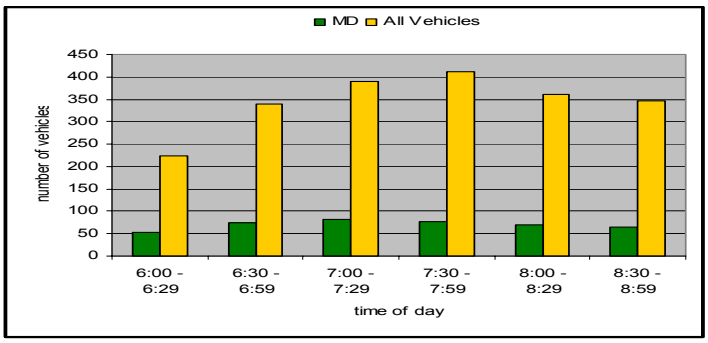
Site 15W2	MD	Total	MD %
6:00 - 6:29	88	417	21%
6:30 - 6:59	134	574	23%
7:00 - 7:29	122	611	20%
7:30 - 7:59	129	698	18%
8:00 - 8:29	92	628	15%
8:30 - 8:59	112	654	17%
Total	677	3582	19%



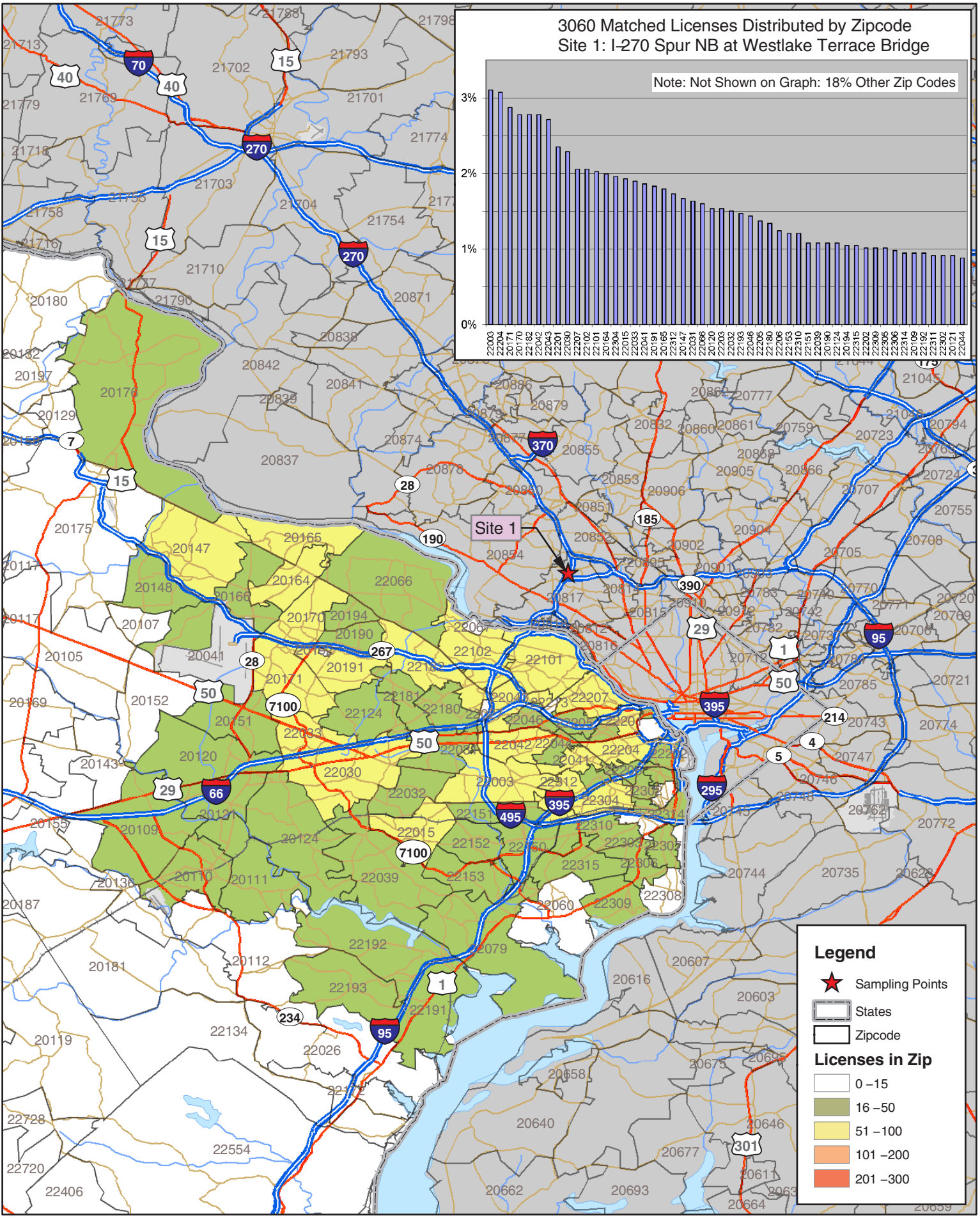
Virginia Site 15 – Lane 3 West
Location: I-66 Mainline WB at Jermantown Road Bridge

2,073 Total Vehicles (419 Vehicles w/ Maryland License Plates) = 20%

Site 15W3	MD	Total	MD %
6:00 - 6:29	54	225	24%
6:30 - 6:59	74	339	22%
7:00 - 7:29	81	390	21%
7:30 - 7:59	76	411	18%
8:00 - 8:29	70	361	19%
8:30 - 8:59	64	347	18%
Total	419	2073	20%

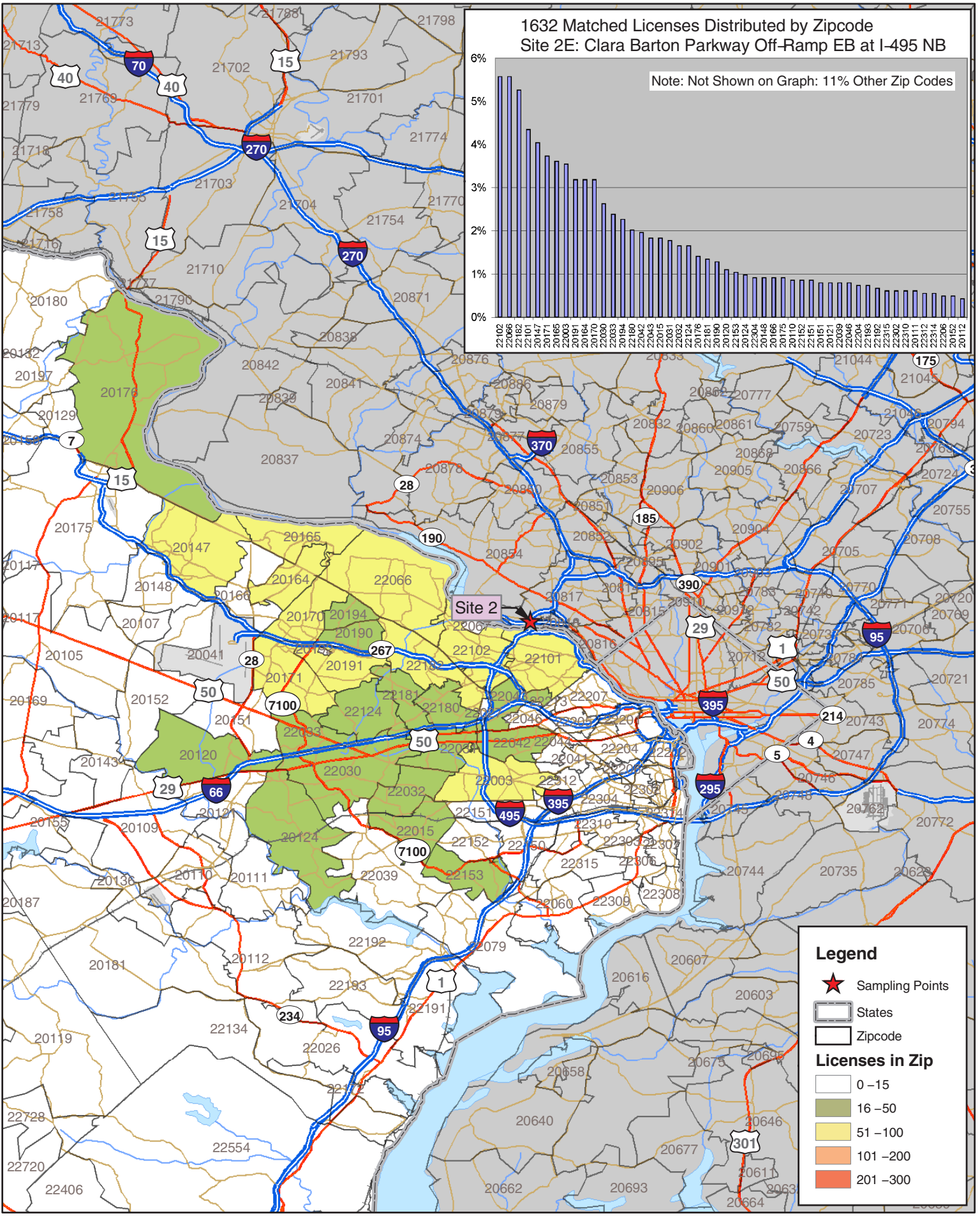


Appendix B—Zip code Plots of Vehicle Owner for Vehicles Observed by Site



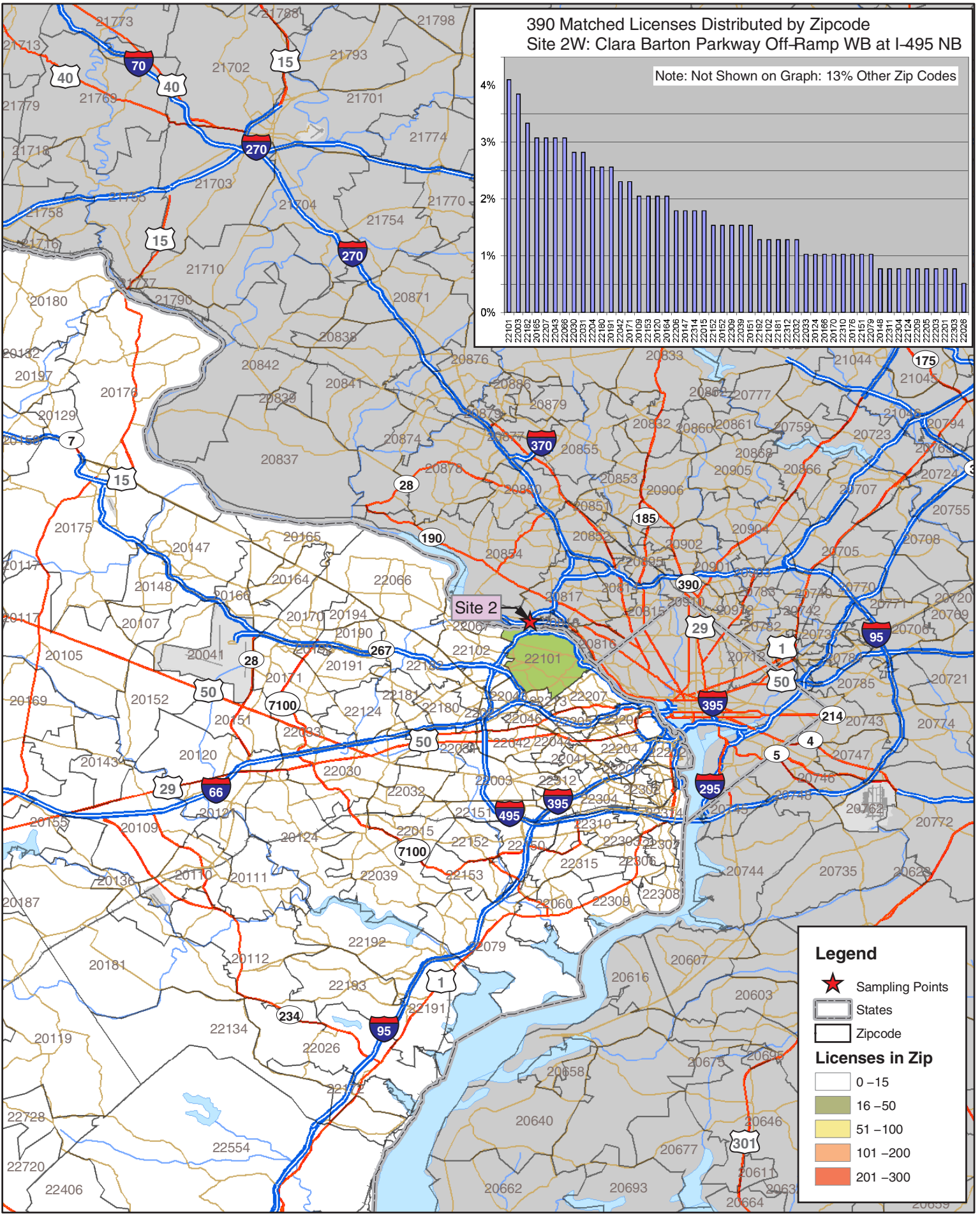
Vanasse Hangen Brustlin, Inc.

Figure B–1
VA Traffic Counts by Zip Codes
I–270 at Westlake Terrace –Site 1



Vanasse Hangen Brustlin, Inc.

Figure B–2E
VA Traffic Counts by Zip Codes
Clara Barton East –Site 2E

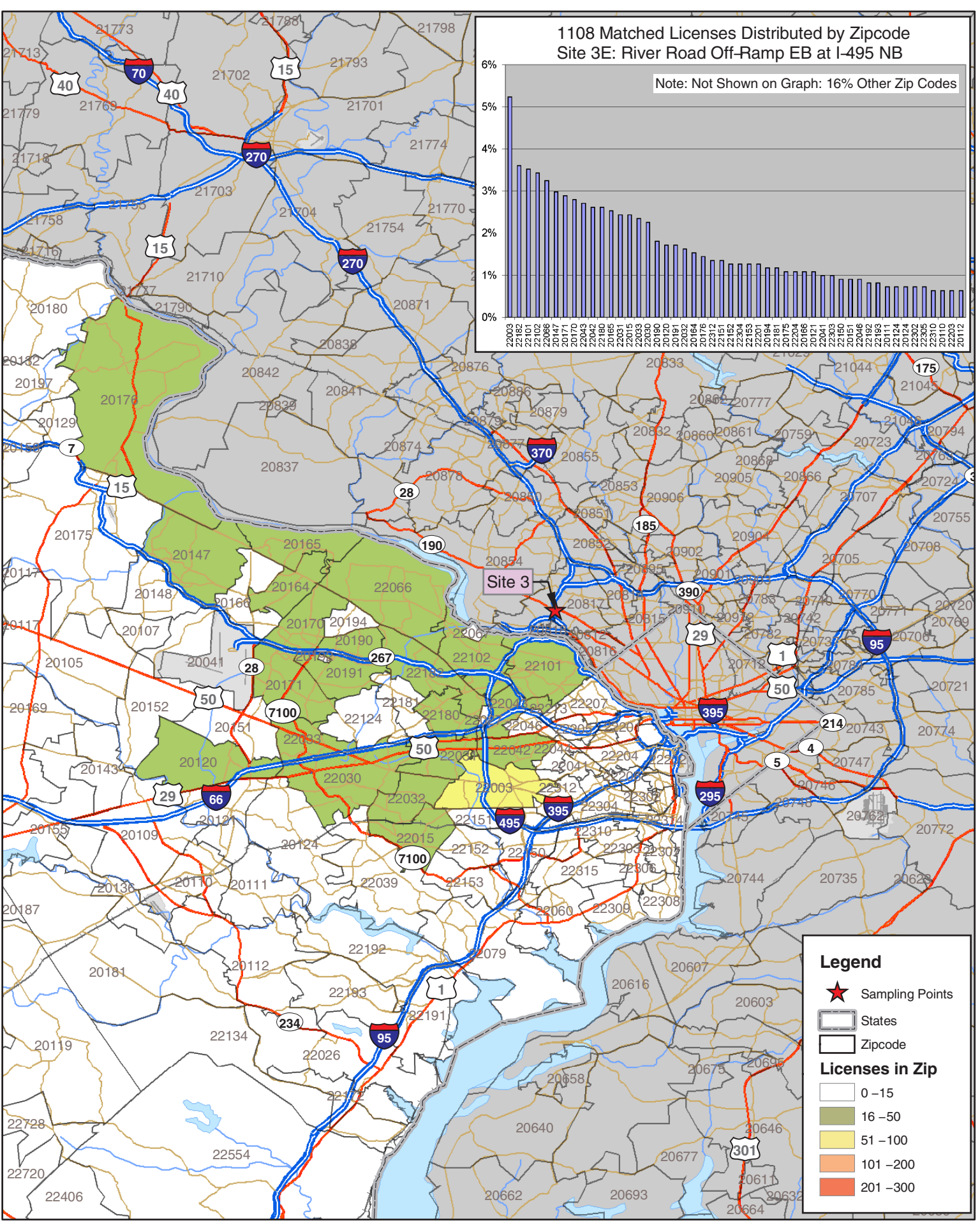


Vanasse Hangen Brustlin, Inc.

N

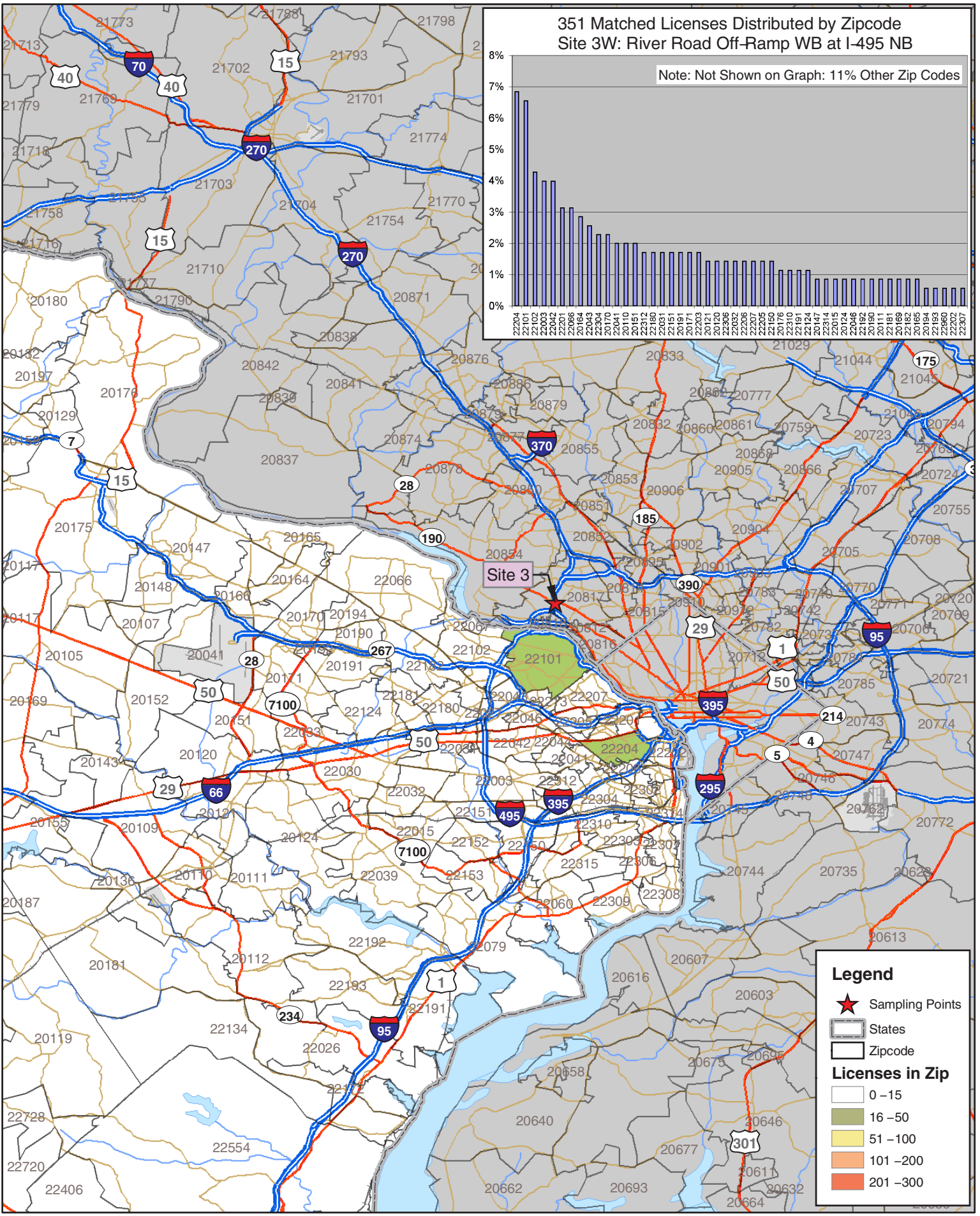
0 2.5 5 10 Miles

Figure B–2W
VA Traffic Counts by Zip Codes
Clara Barton West –Site 2W



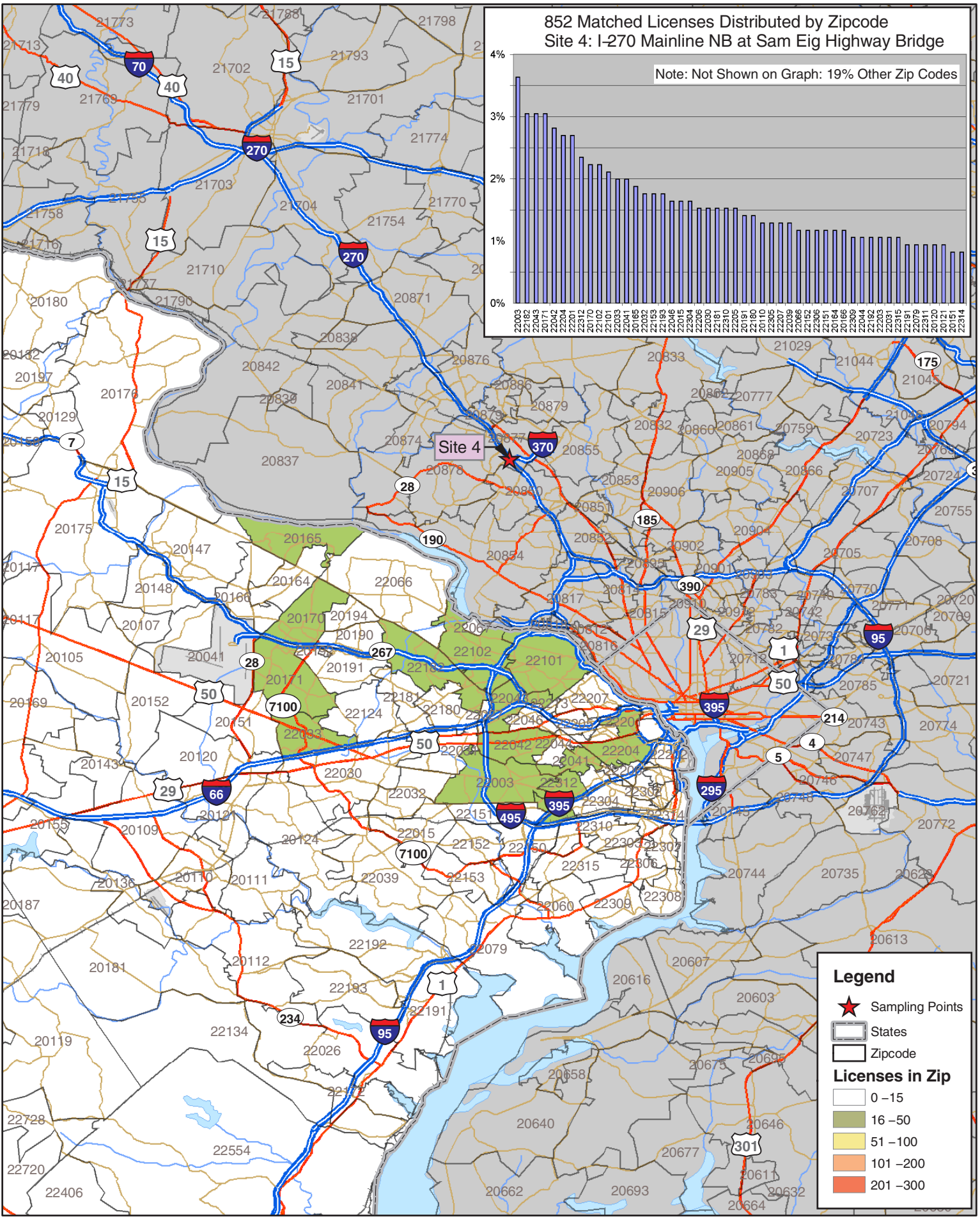
Vanasse Hangen Brustlin, Inc.

Figure B–3E
VA Traffic Counts by Zip Codes
River Rd East –Site 3E



Vanasse Hangen Brustlin, Inc.

Figure B–3W
VA Traffic Counts by Zip Codes
River Rd West –Site 3W

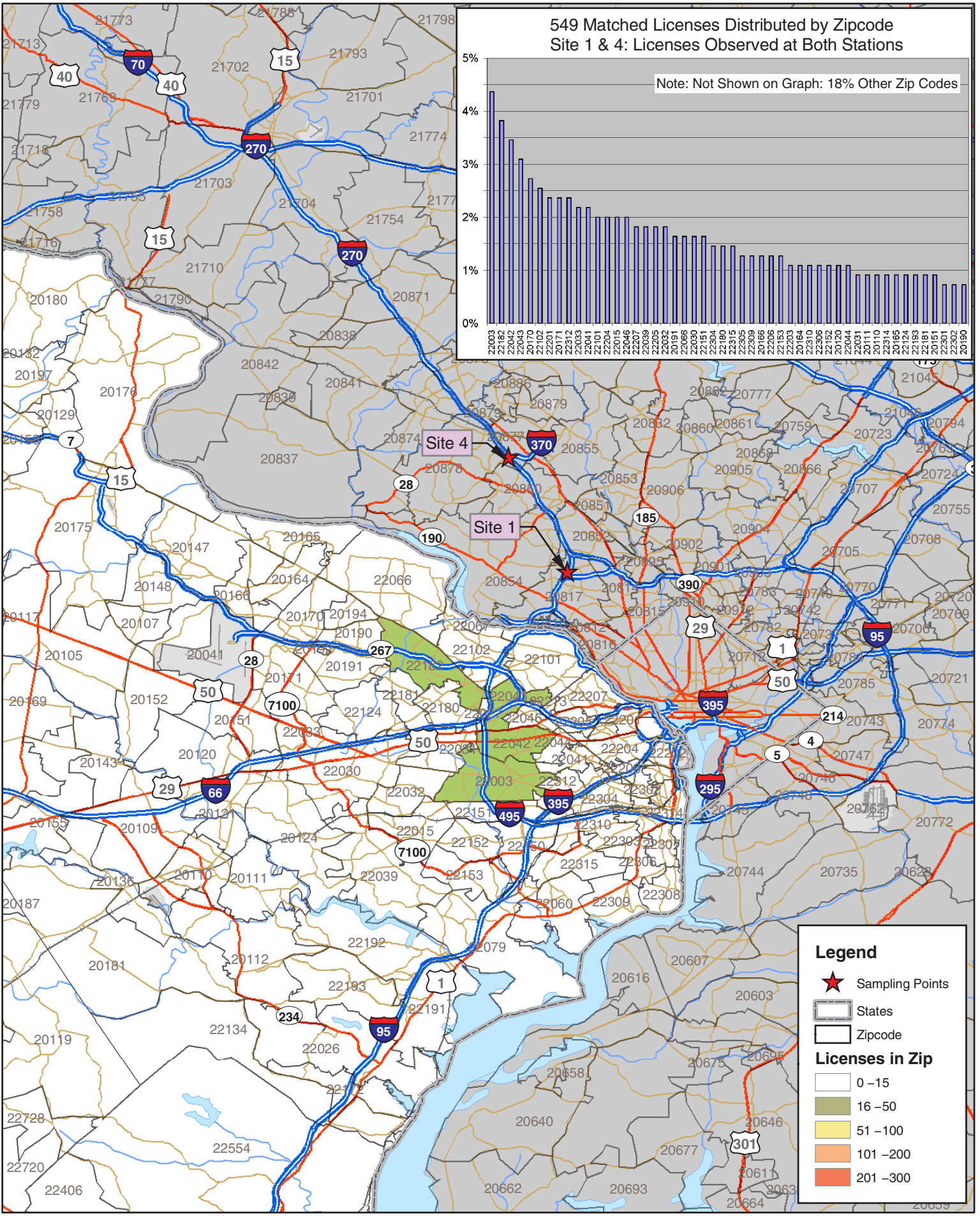


Vanasse Hangen Brustlin, Inc.

N

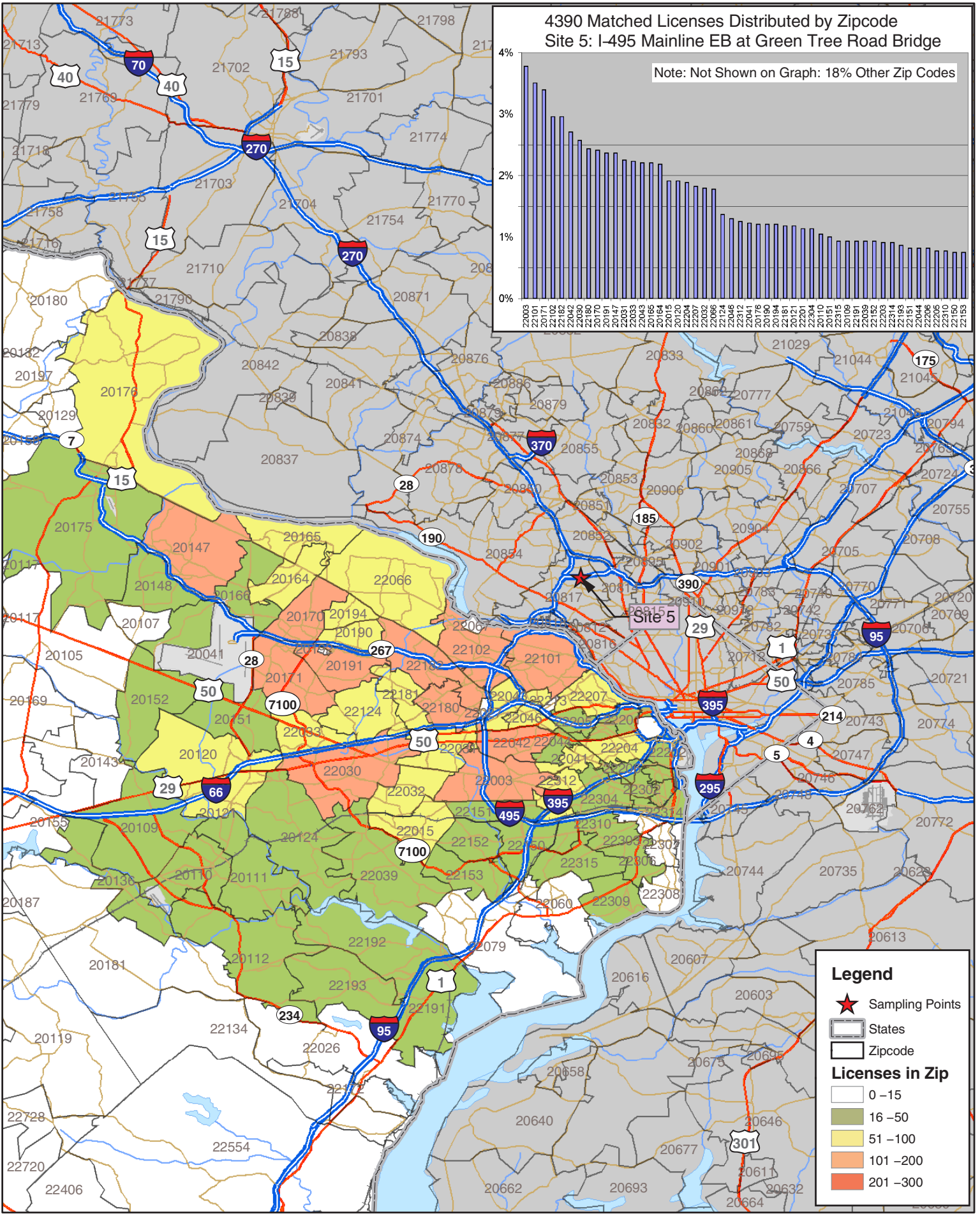
0 2.5 5 10 Miles

Figure B-4
VA Traffic Counts by Zip Codes
I–270/Sam Eig North –Site 4



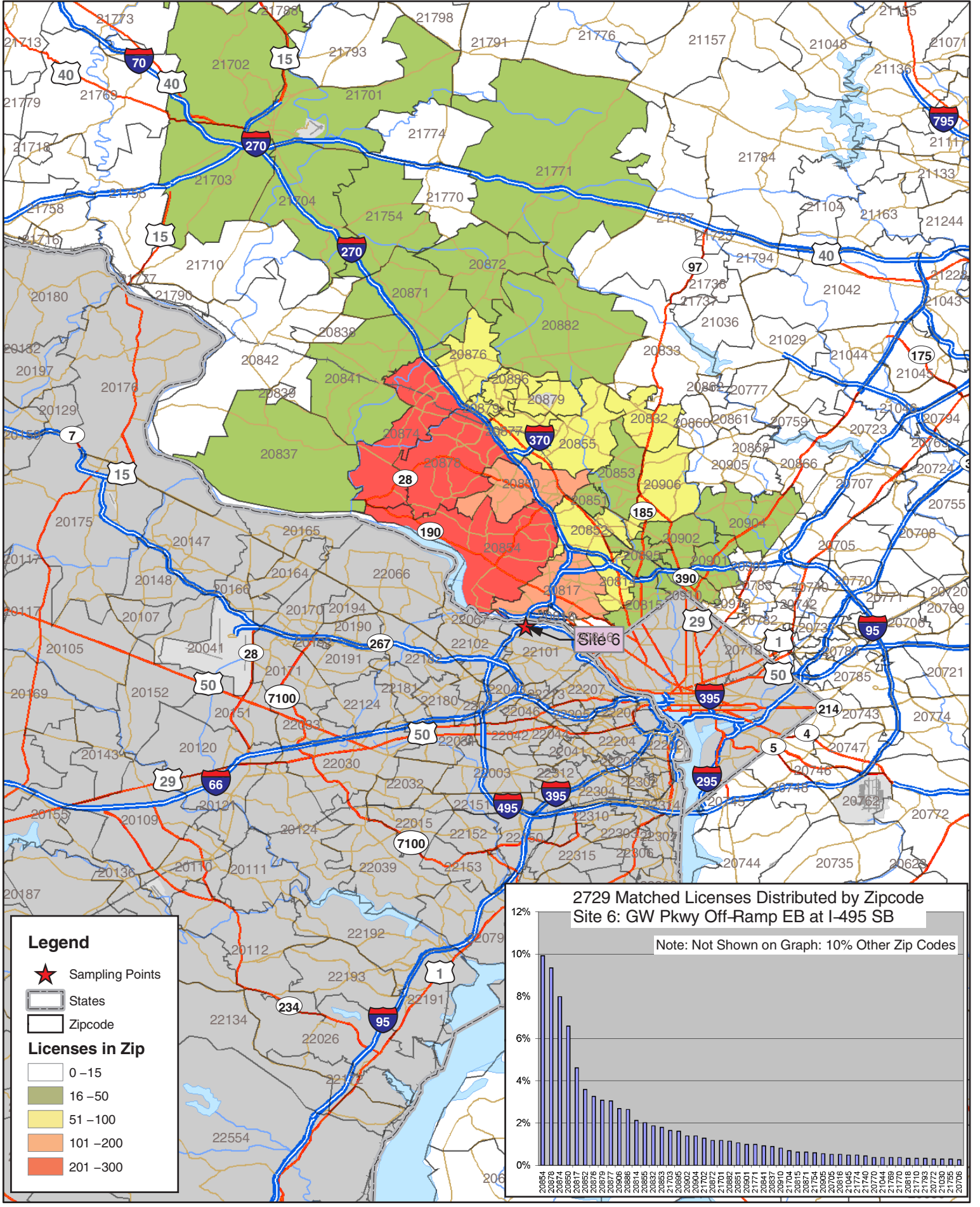
Vanasse Hangen Brustlin, Inc.

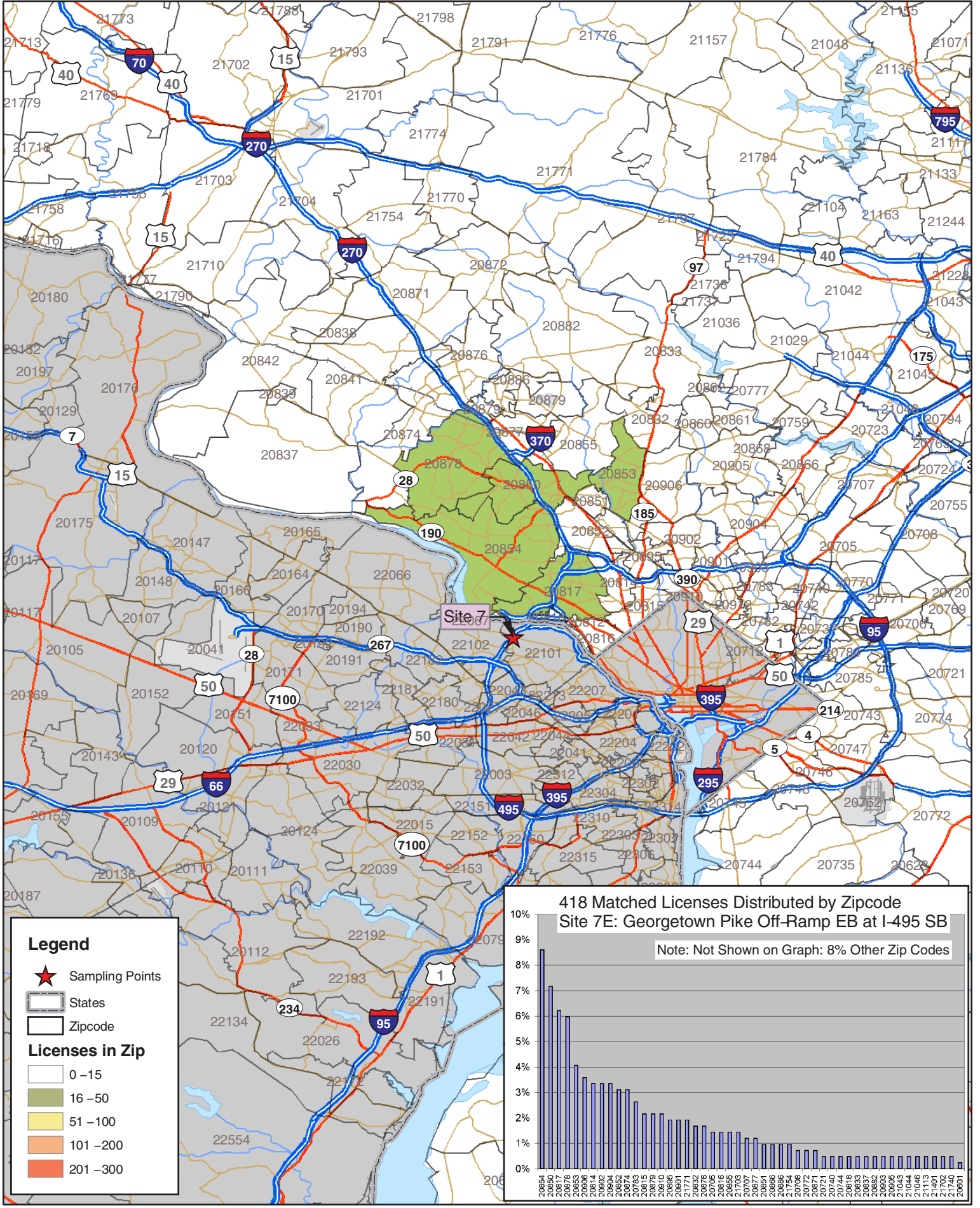
Figure B–1&4
VA Traffic Counts by Zip Codes
I–270 North –Observed Both Sites 1&4



Vanasse Hangen Brustlin, Inc.

Figure B-5
VA Traffic Counts by Zip Codes
I-495 Mainline East –Site 5


Site 6
Legend
Sampling Points
States
Zipcode
Licenses in Zip
0 –15
16 –50
51 –100
101 –200
201 –300
2729 Matched Licenses Distributed by Zipcode
Site 6: GW Pkwy Off-Ramp EB at I-495 SB
Note: Not Shown on Graph: 10% Other Zip Codes
12%
10%
8%
6%
4%
2%
0%
20854 20878 20874 20850 20817 20852 20876 20879 20877 20906 20886 20814 20855 20832 20853 20703 20895 20902 20904 20872 20701 20882 20851 20901 21771 20841 20837 20910 21704 20815 20871 21754 20905 20705 20816 21045 21774 21740 20770 21044 21779 20818 21710 21793 20772 21030 21755 20706

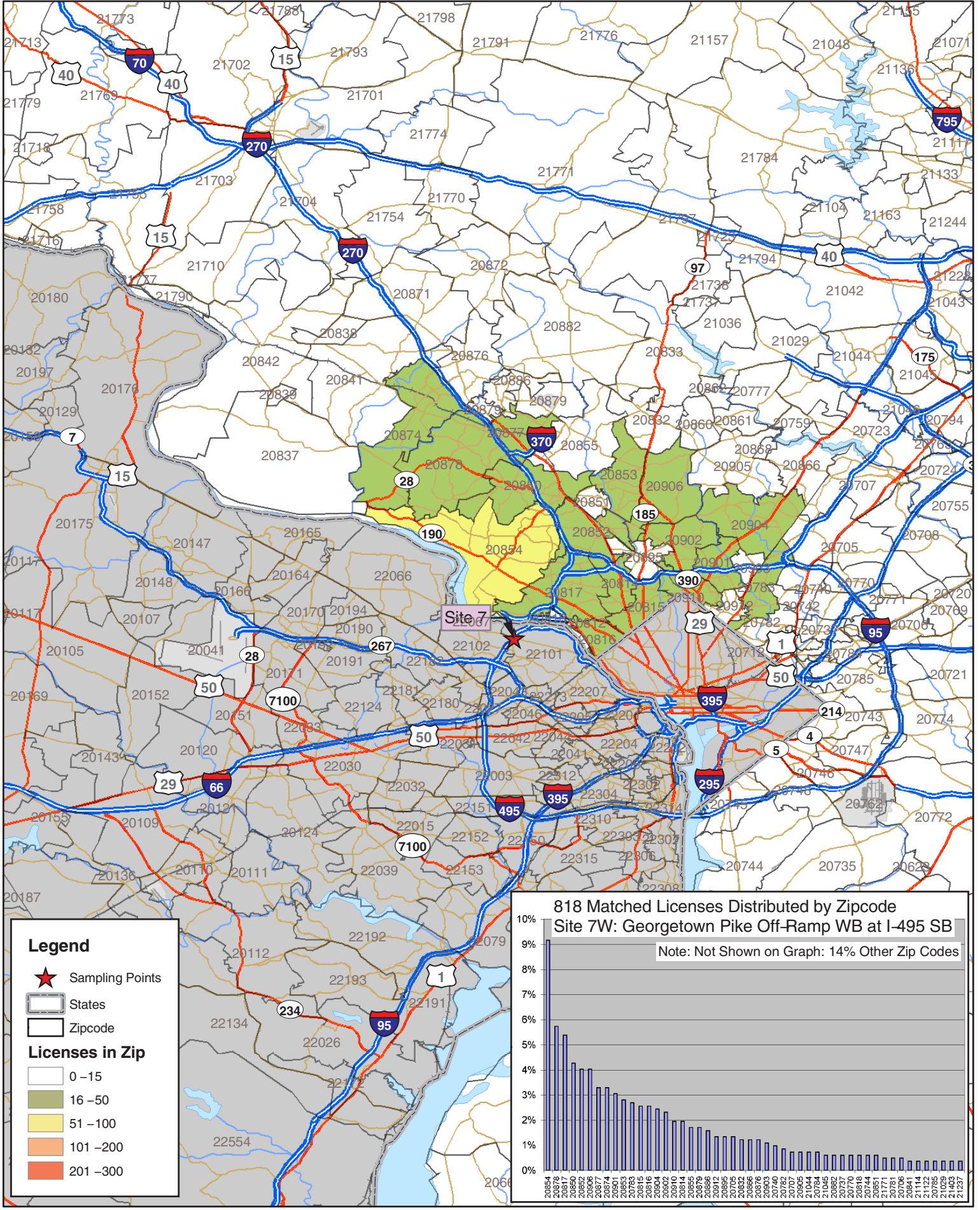


VHB Vanasse Hangen Brustlin, Inc.

N

0 2.5 5 10 Miles

Figure B–7E
MD Traffic Counts by Zip Codes
Georgetown Pk East –Site 7E

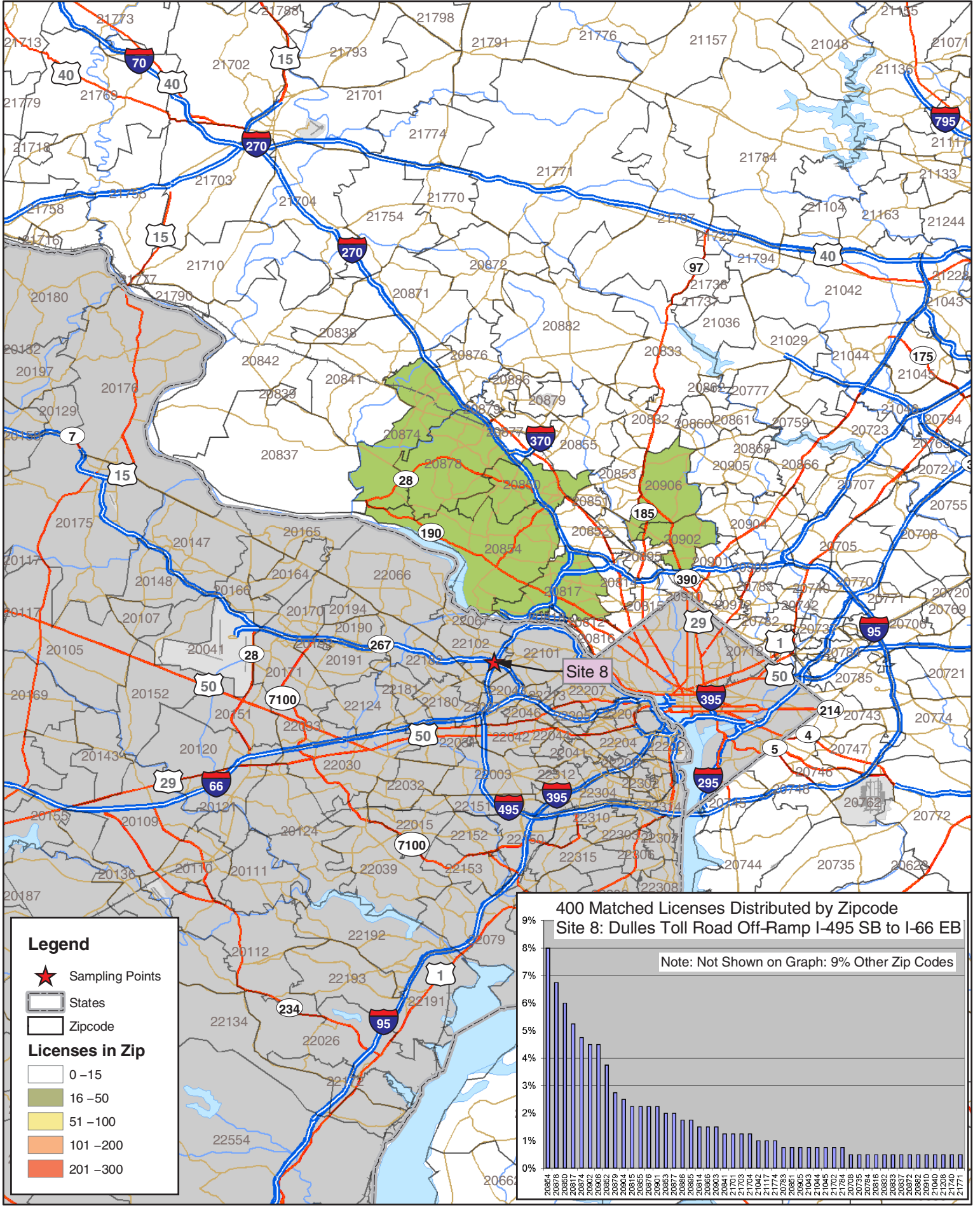


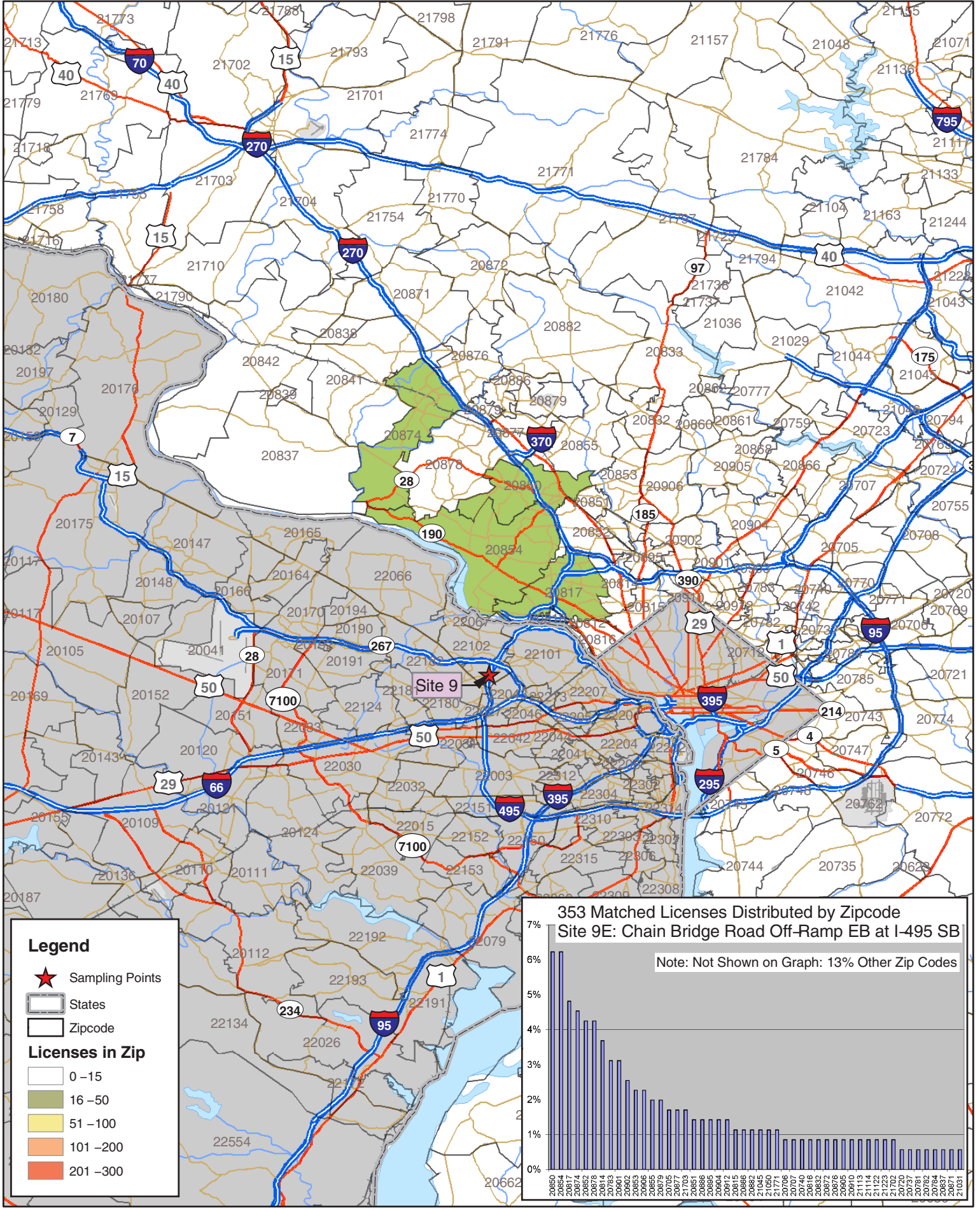
Vanasse Hangen Brustlin, Inc.

N

0 2.5 5 10 Miles

Figure B–7W
MD Traffic Counts by Zip Codes
Georgetown Pk West –Site 7W


Site 8
Legend
Sampling Points
States
Zipcode
Licenses in Zip
0 –15
16 –50
51 –100
101 –200
201 –300
400 Matched Licenses Distributed by Zipcode
Site 8: Dulles Toll Road Off-Ramp I-495 SB to I-66 EB
Note: Not Shown on Graph: 9% Other Zip Codes
9%
8%
7%
6%
5%
4%
3%
2%
1%
0%
20854 20878 20850 20877 20874 20902 20906 20852 20879 20904 20815 20876 20901 20853 20886 20877 20895 20814 20866 20903 20841 21701 21704 21117 21774 20783 20851 20905 21043 21044 21045 21702 21784 20706 20735 20784 20816 20832 20837 20872 20882 20910 21040 21208 21740 21771

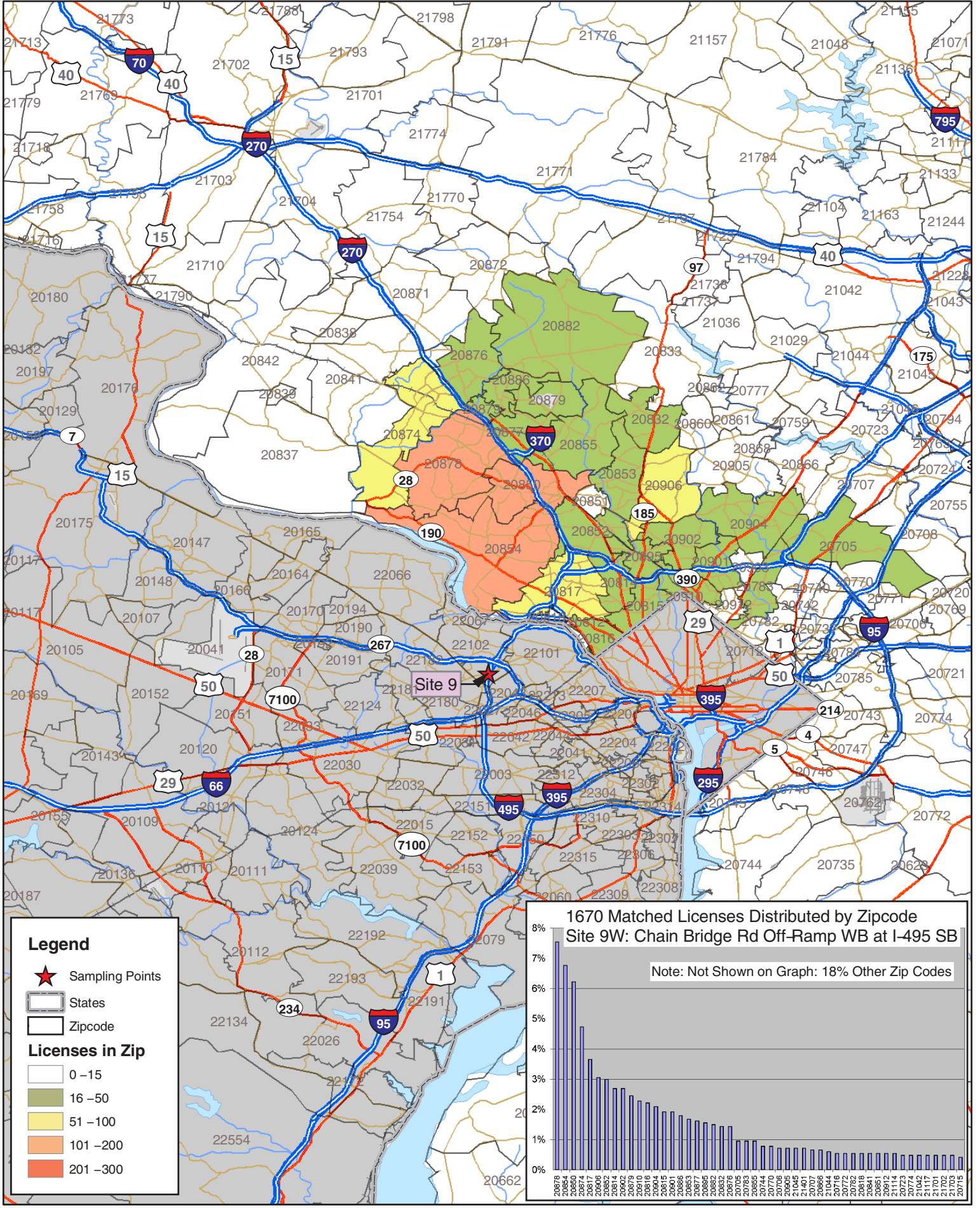


Vanasse Hangen Brustlin, Inc.

N

0 2.5 5 10 Miles

Figure B-9E
MD Traffic Counts by Zip Codes
Chain Bridge East – Site 9E

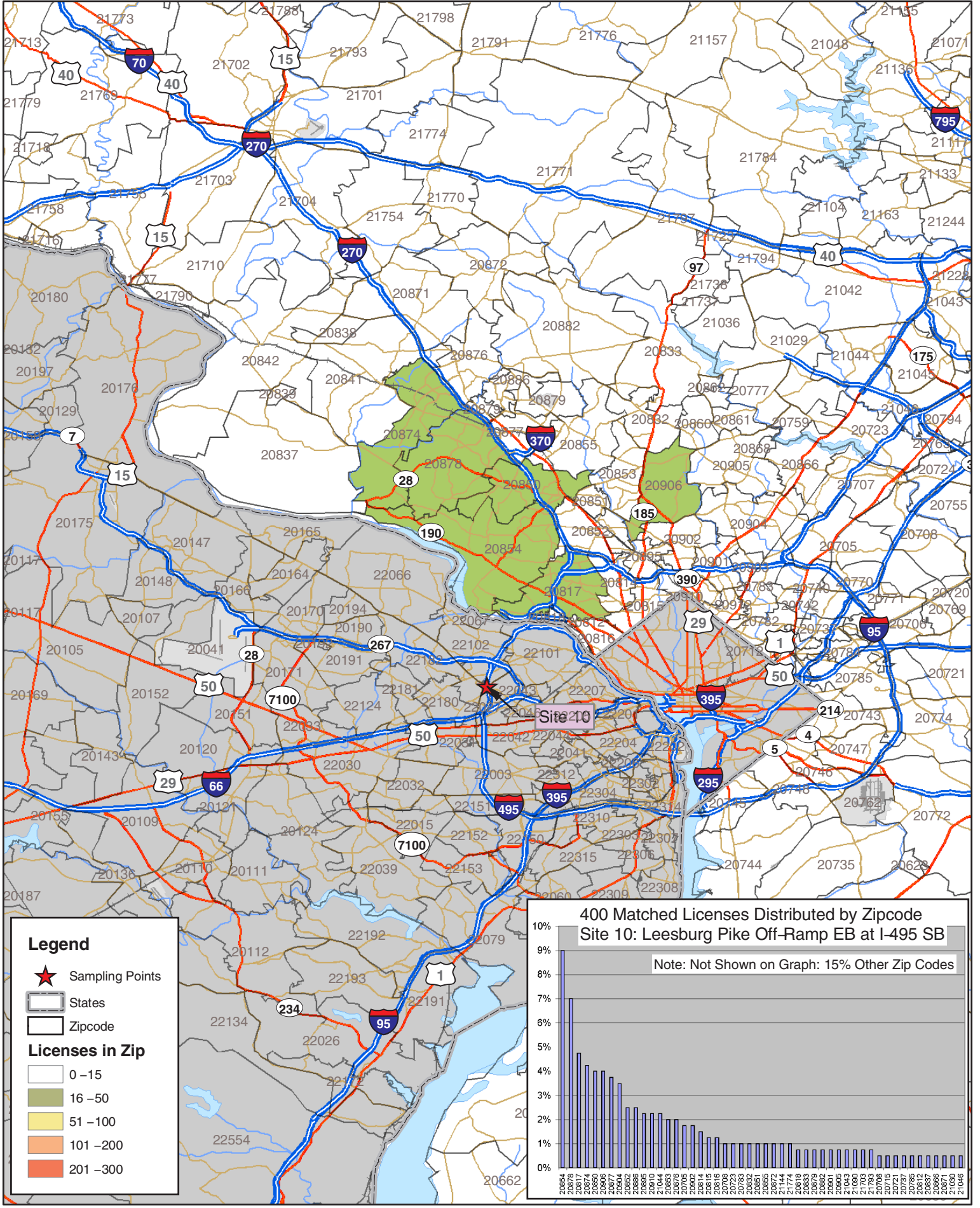


Vanasse Hangen Brustlin, Inc.

N

0 2.5 5 10 Miles

Figure B-9W
MD Traffic Counts by Zip Codes
Chain Bridge West –Site 9W

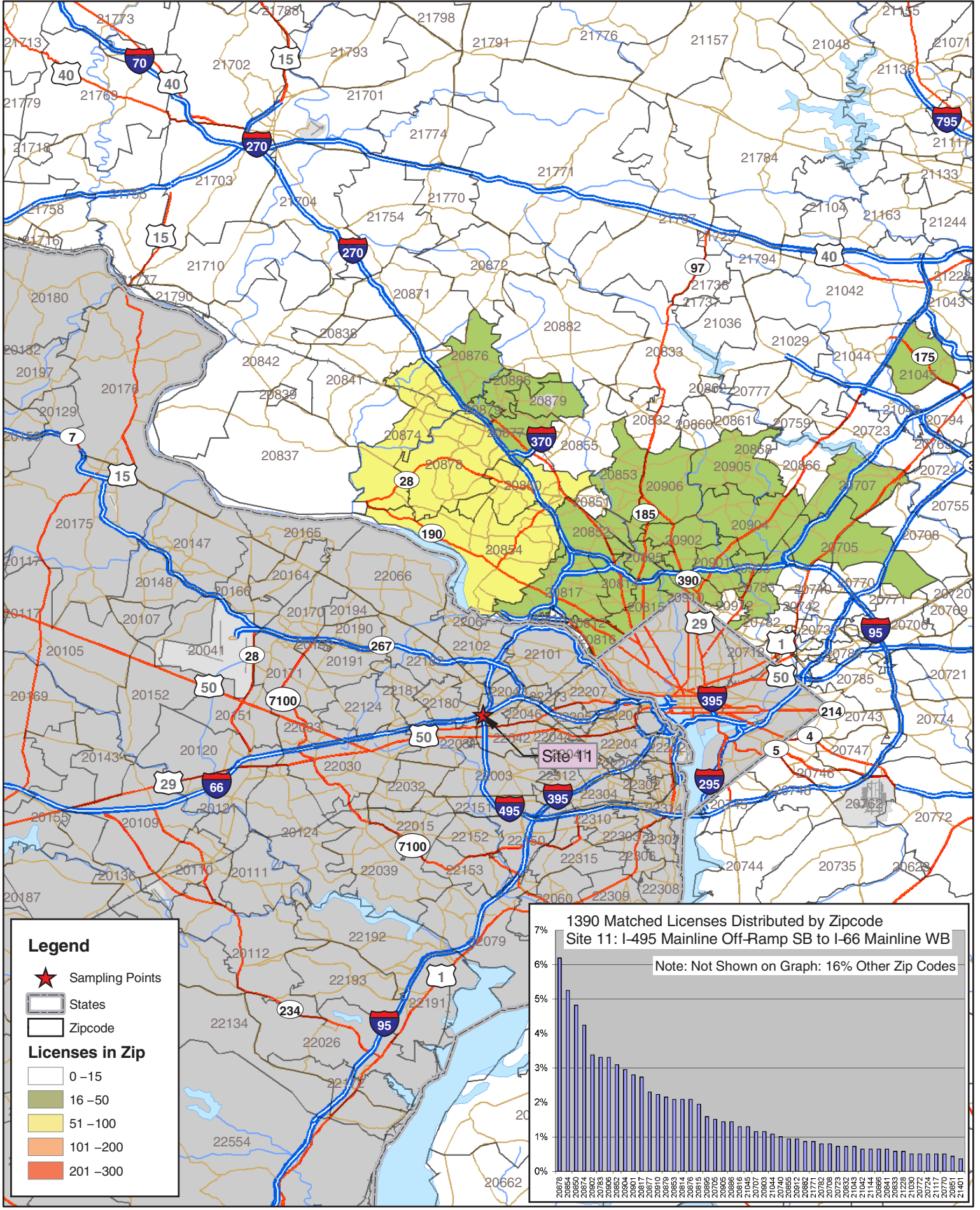


Vanasse Hangen Brustlin, Inc.

N

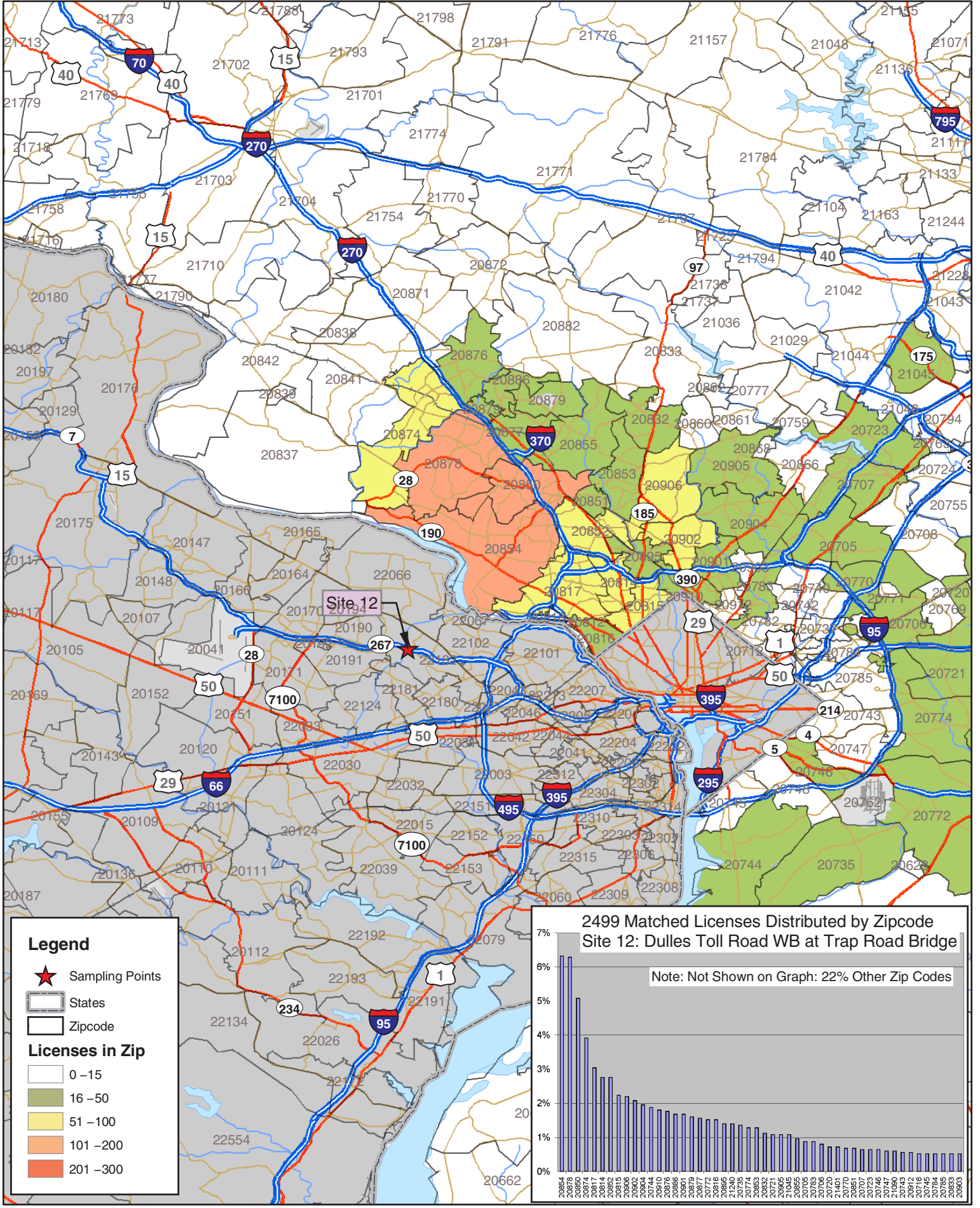
0 2.5 5 10 Miles

Figure B–10
MD Traffic Counts by Zip Codes
Leesburg Pk East –Site 10



Vanasse Hangen Brustlin, Inc.

Figure B–11
MD Traffic Counts by Zip Codes
I-495 to I-66 West –Site 11

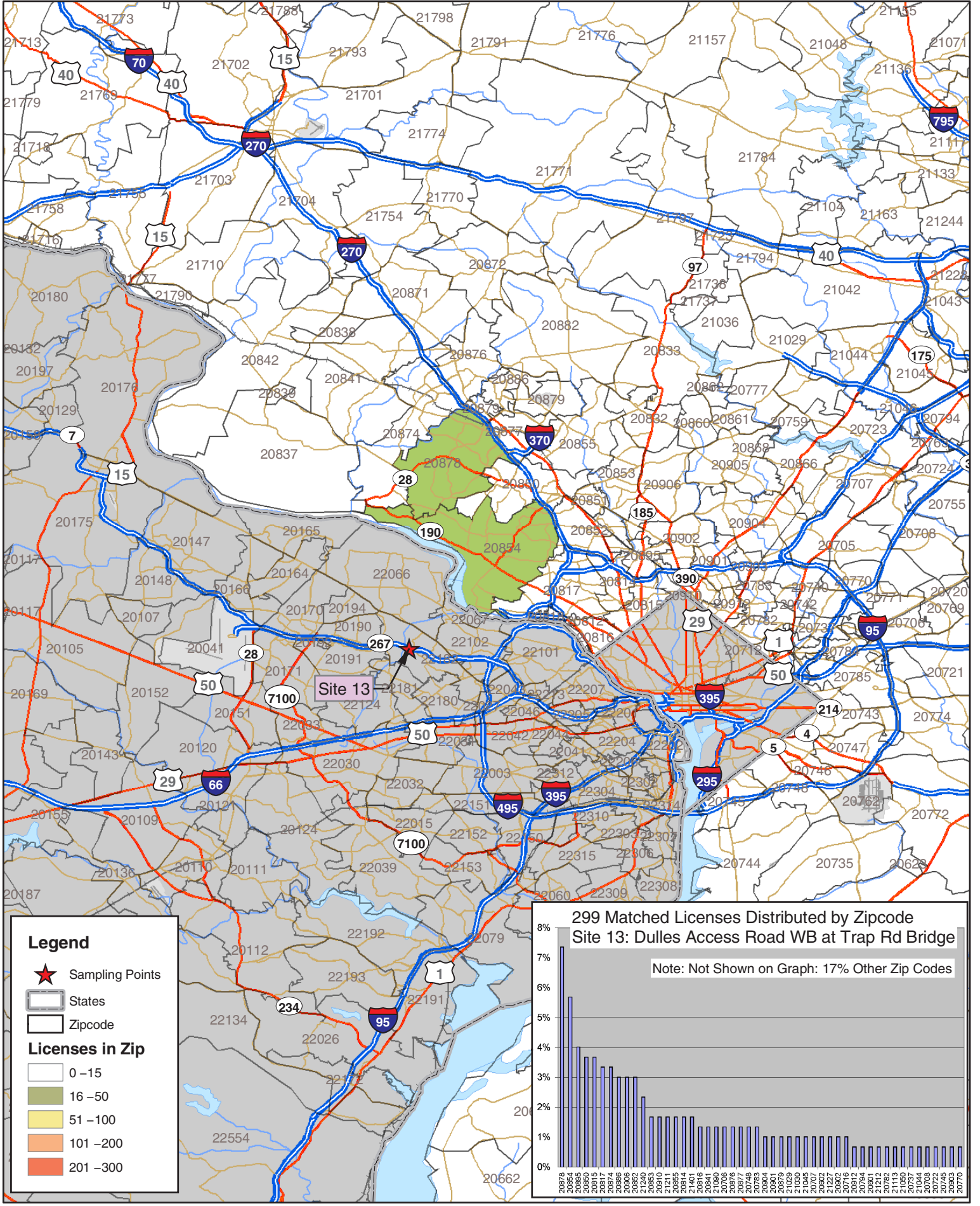


Vanasse Hangen Brustlin, Inc.

N

0 2.5 5 10 Miles

Figure B–12
MD Traffic Counts by Zip Codes
Dulles Toll West –Site 12

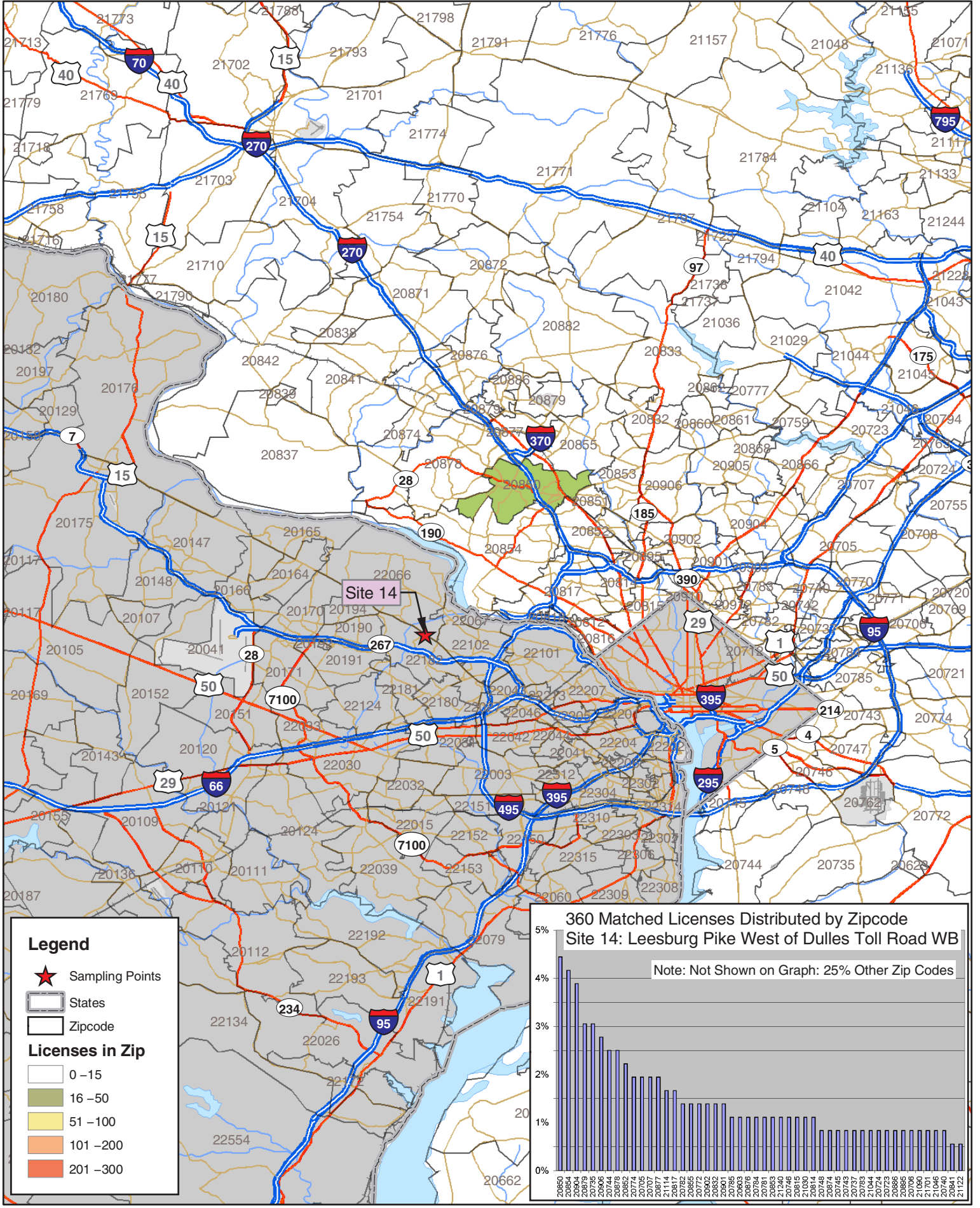


Vanasse Hangen Brustlin, Inc.

N

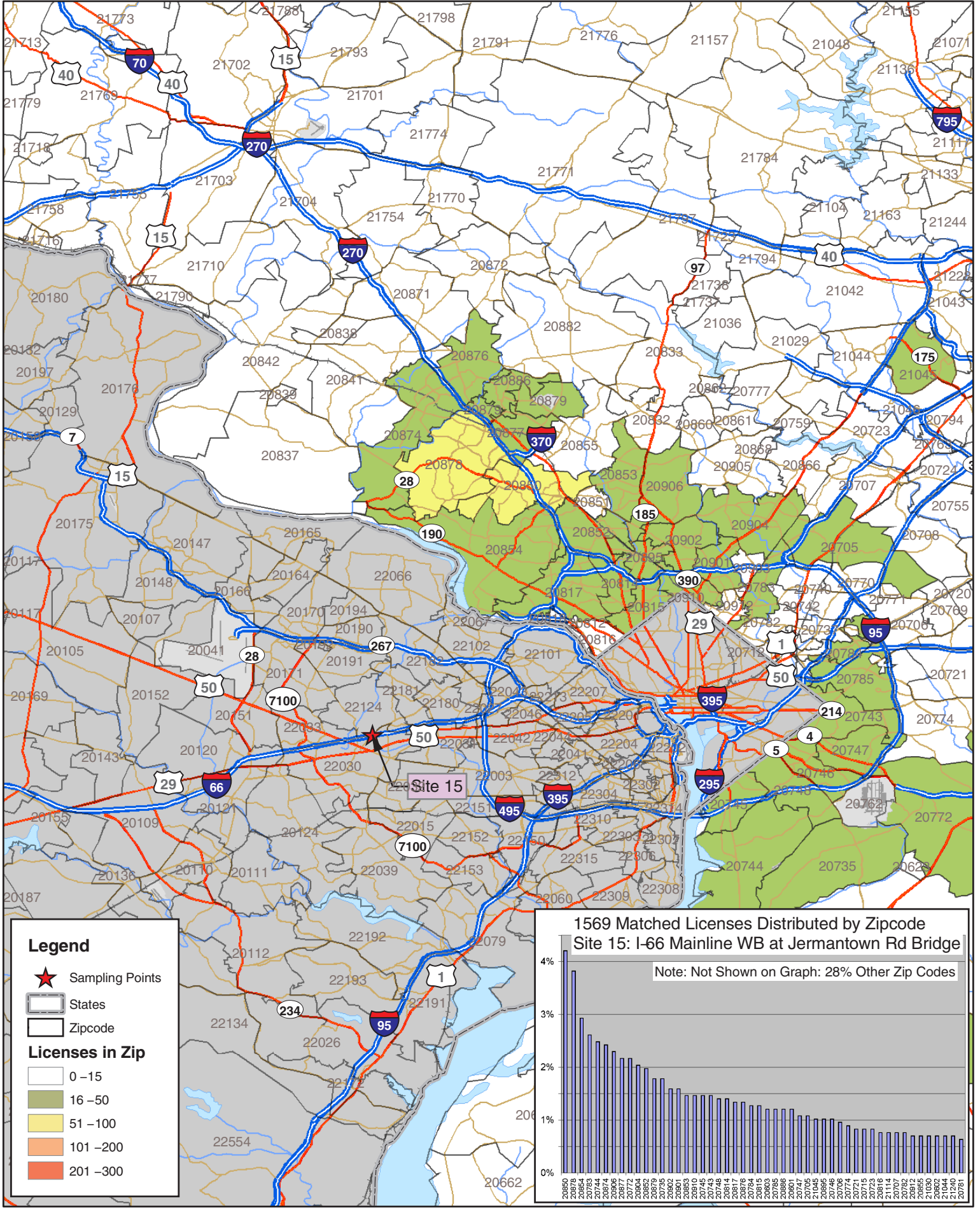
0 2.5 5 10 Miles

Figure B–13
MD Traffic Counts by Zip Codes
Dulles Access West –Site 13



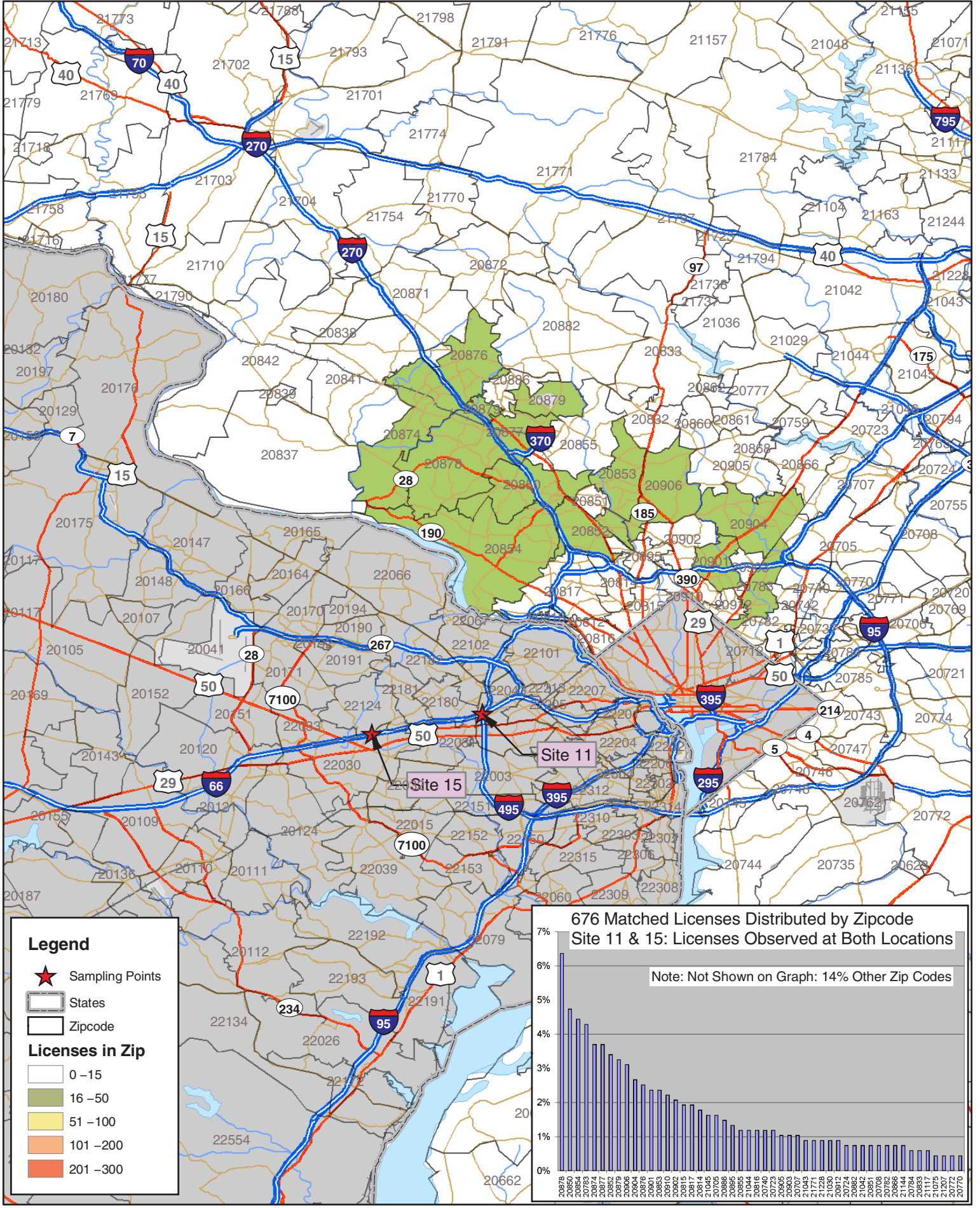
Vanasse Hangen Brustlin, Inc.

Figure B–14
MD Traffic Counts by Zip Codes
Leesburg Pk West – Site 14



Vanasse Hangen Brustlin, Inc.

Figure B–15
MD Traffic Counts by Zip Codes
I-66 at Jermantown West –Site 15



Vanasse Hangen Brustlin, Inc.

N

0 2.5 5 10 Miles

Figure B–11 & 15
MD Traffic Counts by Zip Codes
I-66 West –Observed Both Sites 11&15